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PROCEEDINGS 35TH YEAR

JOURNAL

OF THE

AMERICAN WATER WORKS ASSOCIATION

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JOURNAL

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AMERICAN WATER WORKS ASSOCIATION

The Association is not responsible, as a body, for the facts and opinions advanced in any of the papers or discussions published in its proceedings.

VOL. 2 JUNE 1915 No. 2

MINUTES OF PROCEEDINGS THIRTY-FIFTH ANNUAL CONVENTION AMERICAN WATER WORKS ASSOCIATION

The Thirty-fifth Annual Convention of the American Water Works Association was held at the Hotel Gibson, Cincinnati, Ohio, on May 10, 11, 12, 13 and 14, 1915.

The following local committees had charge of the arrangements for the reception of members and visitors and ladies, and their entertainment during their stay in Cincinnati:

LOCAL COMMITTEES

HONORARY COMMITTEE

Hon. Frederick S. Spiegel, Mayor

Hon. Philip Fosdick, Director Public Service

Hon. John R. Holmes, Director of Public Safety

GENERAL COMMITTEE OF ARRANGEMENTS

John W. Hill, Chairman

F. C. Bitgood, Vice-Chairman
William B. Melish
August Herrmann
Charles H. Anderson
Dawson Blackmore
Thomas Ford
James E. Brady
Carl Dehoney
George W. Cleveland
Royal Mattice

S. G. Pollard, Secretary
E. B. Amole
J. A. Hiller
Gustav Jarecki
Henry C. Hill
J. W. Ellms
J. J. Conway
H. Resinberg, Newport, Ky.
J. Mason Howk, Covington, Ky.
R. P. Bricker, Shelby, Ohio

Frank S. Krug

CITIZENS' ENTERTAINMENT COMMITTEE

William B. Melish, Chairman
S. W. Coffman, Treasurer Carl Dehoney, Secretary

FINANCE COMMITTEE

George W. Cleveland, Chairman

E. B. Amole	G. W. Galbraith
F. C. Bitgood	John W. Hill
Dawson Blackmore	Gustav Jarecki
Philip Fosdick	William B. Melish
Maurice J. Freiberg	Royal Mattice

Howard Wurlitzer

FIRST SESSION—TUESDAY MORNING, MAY 11, 1915

The session was called to order by Mr. John W. Hill, Chairman of the General Committee of Arrangements, who referred to the fact that Cincinnati was now entertaining the Association for the second time in its history, the first Convention having been held in the old Gibson House in 1884, when he joined the Association, Mr. Hill being now the oldest living member in the city of Cincinnati.

Mr. Hill then introduced Hon. Frederick S. Spiegel, Mayor of Cincinnati, who delivered an address of welcome in behalf of the city.

ADDRESS OF WELCOME—HON. FREDERICK S. SPIEGEL, MAYOR OF CINCINNATI

Mr. Chairman and Members of the American Water Works Association: This is your thirty-fifth annual meeting. I want to assure you that we are proud, that I am proud as the official representative of our city of Cincinnati, to have you with us. Conventions of the kind that you are having in our city during this week are always welcome. We have had many such, but it is an especially great pleasure to welcome you men who are not only men of scientific training, but every one of you is endeavoring in your particular field to create a higher standard and bring to the utmost perfection that which has become an absolute necessity to all of our people, the water which we drink. Every one of you in his particular field is doing what all the rest of us are doing in our particular fields, whether we are engaged as professional men in the practice of law, medicine, or divinity. All of us are endeavoring to achieve what is best in our chosen fields of activity.

The fact that you are here the second time proves to me that you have a feeling of attraction for our city that has been known for years and years as the Queen City of the West.

Our city is so fortunate as to be located midway between the south and the north. We therefore partake of the qualities of both sections of our country. The hospitality of the south is ours, and the thrift and the activity of the north. We are glad to extend that hospitality to those who come to us, and we sympathize with those who are engaged in callings that call for hard work and hard study.

Cincinnati has become famous for institutions in which you are particularly interested. I think that I may safely say that we surpass in some of these perhaps every city in this country of ours, this great United States of America.

Our water works as they are at present have among other benefits conferred upon us reduced the death-rate from diseases and particularly that disease which is due to insanitary water supply, perhaps twenty-five per cent. We are delivering sixty million gallons of water a day for the use of our citizens, pumped out of the Ohio River; and every one of you men who know all about water and its qualities, know that water pumped out of a river without treatment is unfit to drink.

Cincinnati has taxed itself in order to develop possibly the finest water works in our country. Our filtration plant, our high-pressure service for bringing the water into every part of our city, our machinery and all of the equipment of our water works plant, are the pride of our city.

After we had completed the water works our city proceeded in other lines of progress. We established an educational system which is not merely academic, which does not merely teach that which is known as an academic course, but our common schools with our great municipal university at their head, also include in their educational training scientific training. It is the aim of our educational system to train our youth in everything that will fit them for an active career of usefulness in their future lives.

Only three weeks ago, or possibly four weeks, I took over as the representative of our city one of the greatest hospitals in these United States, comprising twenty-nine buildings, all fitted up and equipped with the most modern surgical and pathological equipment, in fact, everything necessary in the domain of healing disease.

This hospital will be open for you to inspect, and I hope that you will go through all of the buildings and see how admirably they are adapted for the purposes for which they are designed. I know that you will feel that we have a right to be proud of that general hospital.

We have here in Cincinnati a zoological garden where Hardenberg, when he comes to this country, leaves his animals. It is one of the finest gardens probably in the United States. We have an art museum to which one of the magnificent women of our city who is famed for her philanthropy and civic pride has given a Velasquez, purchased at a cost of $200,000, and which is now the property of the city of Cincinnati.

Now that you are with us we want you to see this city of ours for yourselves, and after you have seen it, I am certain you will agree that it merits all that I have claimed for it.

The doors of our city are open to you and we welcome you here. I have a great big key in my private office at the City Hall, so big that I could not bring it down unless I got two or three people to come along with me and help carry it. It is very heavy. But you need no key to open to you our doors. There is nothing too good for you in Cincinnati. Enjoy our hospitality to the full, and also all of your ladies, your wives, your sisters, and your sweethearts enjoy it with you. It is our desire and our wish that you have everything that we can offer you and all you need do is to send word to the City Hall if there is anything you need, and the Mayor will respond. I thank you. (Applause.)

CHAIRMAN JOHN W. HILL: *Mr. Mayor, Mr. President and Gentlemen*—Some philosopher has said that he indeed is a benefactor who makes two blades of grass grow where one grew before.

It is now my pleasure to introduce to you one of the best known men in the United States, undoubtedly in this country, and perhaps abroad. When I tell you of some of his exploits, although you may never have heard his name spoken in your own communities or mentioned in the public press; you may never have known him or at least many of you have not until this time, you will now recognize in the next speaker a man who has done more perhaps for the benefit of mankind than any man in or out of Cincinnati. I speak advisedly as an engineer, and you know that engineers are bound to be reasonably correct in their estimates of people as well as other things.

He was a member of the legislature when the water works law under which we built our magnificent system of water works that

Judge Spiegel told you about was enacted; and he worked for that in season and out of season. I know something about that, because I assisted in that matter myself at that time. This gentleman was earnest in advocating this measure.

With your permission, I will now introduce Hon. Philip Fosdick, Director of Public Service of Cincinnati. (Applause.)

ADDRESS BY HON. PHILIP FOSDICK, DIRECTOR PUBLIC SERVICE, CINCINNATI

Mr. Hill, Mr. Mayor, Mr. President and Gentlemen—I am going to give you a very brief synopsis by way of a comparison of our water works today with what they were twenty years ago. I will make it very brief.

On March 31, 1817, the first franchise was granted for a water works in Cincinnati. On July 3, 1821, the first water was pumped. On June 25, 1839, the then existing water works became the property of the city of Cincinnati. On April 24, 1896, the new water works act was passed by the General Assembly of Ohio. On February 2, 1897, the Supreme Court of Ohio sustained the validity of the Act. On June 1, 1897, preliminary surveys were begun. On May 15, 1897, construction was begun. On November 1, 1907, the entire city was supplied with filtered water from the new works. On July 1, 1909, the operation of the new works was turned over to the Department of Public Service. Improvements costing two million dollars have been added since the completion of the new works.

There is shown below a comparison of the old and new works in certain particulars, as follows:

	Old	*New*
Quality of water	Muddy, disease laden	Clear, pure
Quantity of water	Barely sufficient	Enough with a large reserve capacity
Typhoid fever cases	Average of four years, 1396	Average of four years, 205
Typhoid fever deaths	Average of four years, 202	Average of four years, 29
Population supplied	Year 1906—346,000	Year 1914—406,000
Average daily consumption	Year 1906—40,000,000	Year 1914—51,000,000
Pumping station	7	3
Number of employees	500	370
Cost of pumpage	$487,000.00	$255,000.00
Total cost of operation	$666,000.00	$509,000.00
Sinking fund and interest	$339,000.00	$713,000.00
Miles of mains	482.0	712.0
Miles of mains greater than 12 inches in diameter	37.5	85.2
Number of service branches	42,765	57,613
Number of metered services	6,536	35,201

Your convention assembled here today certainly means much to Cincinnati and will add vitally to certain phases of our public service as it is utterly impossible for a serious conference among men such as you to be held without doing something for the public good.

It has taken me many years to learn the fact that any step of progress must necessarily be slow, because the slightest advancement over the old means a complete evolution of process and precedent.

We are all engaged upon a serious study to find out what is the best quality of material for street paving, and although we have been studying this question for centuries, we are still far from attaining our object. This is so, because as we study, conditions change, and our line of thought must necessarily be along strange paths. The automobile and the automobile truck, doubtless both in their infancy, bring up new questions, and no sooner have we arrived at what we think is a permanent conclusion, when lo and behold, the entire vehicular question is changed and our minds must shift to the new range.

It seems the distance round the world from the old pump and cistern to the gigantic machine that sends millions of gallons of water to municipal communities every day, and yet I would not be surprised that the future shall produce an equally large advance in the method of furnishing this necessity to human beings who will be grouped together in the cities of the future. The matter is further complicated by the fact that each city possesses characteristics of its own, and each one requires in a measure a different treatment. Take for example the two largest cities in Ohio, Cleveland and Cincinnati. The surface of Cleveland is flat. Cincinnati's topography is as varied as a mountain range, although of course on a smaller scale. The men at the head of the municipal departments here are compelled to overcome steep grades, attain great heights and build on hill sides.

Gentlemen, the Department of Public Service is at your disposal. We think we are progressing in our work in all departments and believe that the people who live in cities are being taken care of by municipalities in a manner our predecessors never dared even to dream of. I am certain that none of the elementary problems of municipal life have been better solved than that of the water supply and the water distribution, and it is to people such as you that we are indebted.

Again, I take the greatest pleasure in welcoming you to our very beautiful city. We have a really beautiful city. Take our park-

way; it is not large, but what there is of it I think is as beautiful as in any city in Europe or America.

I do not want any of you to forget to look at that beautiful view up and down the Ohio River that you can get from Eden Park, or you can look across to the hills of Kentucky. Then there are numerous parks. There is Devou Park over in the state of Ohio, within ten minutes ride of this hotel, which is very beautiful. We have also Ault Park, presented to us by Mr. Ault, from which you get beautiful views of the Miami River.

I have taken up a great deal of your time, and I want to thank you for your attention, and again welcome you to our city. (Applause.)

RESPONSE TO ADDRESSES OF WELCOME

By President George G. Earl, New Orleans, La.

Gentlemen of the Local Committee, and Gentlemen of the Convention: We certainly all deeply appreciate the kindly words of welcome that have been given to us. We feel certain that we are going to have here in this city of Cincinnati a particularly successful convention.

The Association is to be congratulated upon the good attendance, and also upon the energy and progressiveness of this city of Cincinnati of which the Mayor has spoken to some extent.

I feel that perhaps the water works fraternity appreciate even more deeply than I do myself, if that were possible, the position that Cincinnati and Louisville also took in the matter of the investigation when water purification was the problem which was presented to them for their particularly difficult rivers. I know that that problem had been seriously before the city which I represent. I know that when it was proposed there one contractor offered to filter some river water, making all kinds of guarantees, and that the filter company was bold enough to give those guarantees and attempt to filter Mississippi River water without preliminary treatment. I know that that company spent a great amount of money in trying to do that, but found that they had undertaken an absolute impossibility. They could not do it, and the filter company was seriously hurt by the attempt. The city was hurt, and the private company who went into a contract of that kind were hurt, and they were convinced that the Ohio water could not be filtered; and they were betrayed into an attitude which ultimately cost them their franchise.

When that same condition was presented to Louisville, and again to Cincinnati, instead of going blindly into a contract of that kind they insisted upon having some demonstration first, with the result that small amounts relatively of money spent in careful preliminary investigation blazed the trail for future water purification work along those lines, so that when that problem came to me I could look back to the report and studies which Louisville and Cincinnati had worked out and perfected, and could recommend that there was safety and certainty along those lines. It is for that reason, especially, that I feel that the water works fraternity, and most of all those of us who have problems similar to that of Cincinnati and Louisville, feel particularly grateful to the city of Cincinnati.

CHAIRMAN JOHN W. HILL: *Mr. President and Members of the Convention,* I would like to read you the following telegram from Captain Horace Tarr. I think that every one in the Association knows the Captain well. We expected him to be here today. His telegram is as follows:

PHILADELPHIA, May 10, 1915.

John W. Hill,
First National Bank Bldg.,
Cincinnati, Ohio.

Kindly say to my friends that owing to a death in my family today it is impossible for me to be at the convention, which I regret exceedingly, as I should have taken great pride in showing them the California engines. However, I trust to you to do the station honors. With fond regards to all my old associates, I am

Yours H. G. H. TARR.

The following invitation was read by the Secretary:

CINCINNATI, May 6, 1915.

J. M. Diven, Esq.
Secretary-Editor,
American Water Works Association.

Dear Sir: On behalf of the Cincinnati Section of the American Chemical Society, permit me to extend a hearty welcome to our city, and, at the same time to extend an invitation to attend our regular meeting on the evening of May 12, at 8 p.m. at the University of Cincinnati. On this occasion Dr. G. B. Heckel, Secretary of the Educational Bureau of the Paint Manufacturing Association of the United States, will be speaker of the evening. Our interests are mutual and I am sure a profitable and social evening is in store.

Respectfully, CHAS. T. P. FENNEL, *Pres't,*
Cincinnati Section,
American Chemical Society.

ADDRESS BY PRESIDENT EARL

Gentlemen: The making of a presidential address to a great national association is an honor which I never expected to attain, and, to speak truthfully, which I had never desired to attain. It is an honor, moreover, for which I do not feel myself to be properly equipped, and one which I undertake therefore with extreme reluctance.

It was with great regret that I had to forego attendance at the Philadelphia Convention last year, both because it was the first convention of this Association which I had missed since 1909, and because of early personal associations which make the city of Philadelphia particularly attractive to me.

Not having been with you last year, it is now incumbent upon me to express the deep appreciation of, and gratitude which I feel for, the honors that you have conferred upon me in maintaining my name on your official list since 1910, and especially in persisting, after the practice of official succession, which I have always opposed, was supposedly eliminated by the general ballot for nomination, in electing me as your President.

I feel doubly honored in that my name stood with two of your most active and highly regarded members in this ballot, either of whom, you must have known, could serve the Association's interests better than myself, and I am constrained to feel that both of these gentlemen were in large degree parties to the conspiracy which resulted in my election.

The kind expression of Mr. Hill at your last convention, in assuming the Vice-Presidency, as published in the June issue of the Association's *Journal*, was most graceful, and is in particular deeply appreciated.

My inability to attend the last convention, and the distance of my residence from the center of "distribution" of the society's activities, both constitute serious handicaps to the usefulness which the Association has a right to expect from its President. Fortunately, however, the Association has tried and tested men in its active executive positions, and men on its committees who give unstinted effort toward its welfare, and great ability to the solution of its problems, and from their reports, rather than from your President's address, you will gather the record of substantial progress which the year has shown.

In looking over the volumes of this Association's *Journal*, and journals of other associations as well, perhaps the most conspicuous thing is the scope of topics which present themselves as allied with and essential to the present day water works practice. A generation ago, an able man might specialize in water works and reasonably well cover the field; today, a rather modest water works outfit demands specialists in several lines to coöperate in its attainment and its maintenance and operation. And aside from the pleasant social intercourse, the greatest good of this Association lies in the lesson of the necessity of coöperation in any worthwhile accomplishment which it brings home to each of us. It is around this central idea of coöperation that I shall now speak, in its application not only to the individual water works plant, but also to this Association, to the whole water works interests, and to the interest of humanity itself.

Broadly speaking, nothing is worth while which does not advance the interests both of justice and of humanity, and any work undertaken which conforms with these objects should appeal to the people in whose interest it is undertaken. Tactful voicing of this appeal, with clear and candid statements rendered to the public, are essential to the promotion of that coöperation from this source without which no work can prosper.

Not long ago I had the pleasure of dining with the head of one of the country's greatest corporations, and, when the opportunity offered, I asked him what, in his experience, was the hardest vital thing to attain in his management of its affairs. His reply, without any hesitation, was "to keep everybody boosting, not to keep them boosting me, or to keep them boosting the corporation, that is easy, but to keep them boosting one another"—in other words, effectively, helpfully and unselfishly coöperating.

The very qualities of great personal ability and self-reliance, which render many men of inestimable value, tend in some degree to destroy in them the spirit of coöperation and tolerance which are, and always will be, essential to the teamwork, without which the highest success of great undertakings can never be attained, and without which, as their responsibilities grow, they will find themselves unable to progress as they might otherwise.

The organization which has a chief who cannot learn anything from or give any credit to his subordinates, and as a sequence, or even without this inciting cause, has subordinates who are working at cross purposes with their chief and with one another, is seriously

handicapped, not only in its actual work, but also in maintaining the public confidence and coöperation which a united front can maintain, and which is essential, not only to its well-being as an organization, but also to the well-being of the individuals composing it.

The great purpose which associations like the American Water Works Association are accomplishing is in obtaining a constantly wider and more effective coöperation in the diffusion of knowledge and the interchange of ideas looking to the improvement of the various factors which enter into the water works practice of today.

The more interested men, and the more trained men, and the more men who desire to broaden themselves in this field of usefulness, that can be induced to coöperate to these ends, the better will be the results.

Other more or less local water works associations hold meetings and publish valuable papers and reports which this Association could profit by, and these associations in turn themselves could profit equally by the papers and reports of this Association.

Very few water works officials can spare the time or money to attend several conventions each year, and relatively few can belong to two or three associations, and keep up with their papers and reports, and those who have special experiences or ideas of value cannot spare the time, or for one cause or another do not care to repeat substantially the same paper to two or three associations. And when it happens that standards have to be adopted, or any general movement is in progress looking to the interest of the whole water works fraternity, the multiplication of unaffiliated associations is a distinct cause of complication and delay.

Many of us belong to and take great pride in our membership in some of these associations, but holding to the conviction that the greatest good is to be obtained by the broadest possible cooperation, and being unable to attend more than one convention, we have to forego the pleasure and profit which we would have in meeting more of the membership of the other associations than attend the conventions of this Association, and therefore lose the opportunity which might otherwise exist of receiving from or imparting to these much that would be of mutual interest and helpfulness, while those of our members who are able to attend several conventions, and to do their full duty by presenting to two or more associations papers covering valuable contentions in water works matters, are performing a most arduous and unnecessary double duty.

There seems, therefore, to be every possible reason for the union of all of the water works associations of America, with as many local branches and branch conventions and headquarters as can be maintained, but with one national annual convention and one common publication of all papers covering new matter of general interest.

A splendid start in this direction has been made through the present very liberal conditions and regulations offered by this Association for such consolidations and two very desirable connections have already been consummated, with a third in prospect.

I believe that the best interests of all water works associations demand that this movement be continued and accelerated, and the advantages to be gained by all parties of a more prompt and effective coöperation from such consolidations would be so great as to warrant the highest effort and the greatest of mutual concessions. Fortunately, the relations between these various organizations have heretofore always been most pleasant.

A national water works association that included every existing organization and reached every water works in the country could do better work, and could through its larger membership make its work count for more in the obtaining of general public faith and coöperation in its standards and suggestions.

The progress which the physical side of water works problems has made, and is making, speaks loudly and truly of the unselfish coöperation which has always existed and still exists between the allied professions whose efforts are responsible for the advance which by its momentum must continue.

The end which lags and which should be given the best effort of your best minds, however, has reference more to the matter of water rates and accounts and to the means and relations which exist in the matter of connections from the main to the property line, and in the matter of the maintenance of such connection and of the meter which should exist on each connection.

The monumental work which the Committee on the Tabulation of Water Rates and Allied Comparative Data submitted to the Convention at Philadelphia reflects the greatest credit upon the persistence and industry of the Chairman and those members of the Committee who may have been able to coöperate with him in its preparation. It includes over 100 pages of comparative statistics, applying to over 300 cities, and has been prepared with the

greatest care with a view of assembling together an intelligible and comparable résumé of certain features of water works practice. The data include information as to water rates, distribution systems, electrolysis, metered services, source of supply, pumpage, treatment and consumption, public fire service, private fire service, private service lines, and while it represents information of the highest value, as a matter of reference so far as it goes, it tends mainly to emphasize the very wide divergence of practice, and the almost chaotic condition as to what may be considered the best practice in many of these matters.

When we examine in detail the annual reports of water works plants, all over the country, we find even more strongly marked this divergence of practice, and we find ourselves absolutely unable by comparative study of accounts to formulate any satisfactory comparison in almost any matter pertaining to them.

The divergence of conditions and interests, as between publicly and privately owned plants, is one cause of this trouble. The gradual growth of plants, and the cumulative effect and inherent inertia of outgrown conditions, and of accumulated mistakes, are in part responsible. The persistent survival of flat rates for water and illogical conditions as to payment or non-payment for fire protection, based on every conceivable measure of probable use or relative influence, are the main obstacles to any approach to better conditions, and the inherent and obvious inadaptibility of existing meter rate schemes to deal fairly, as between different classes of consumers, is the real stumbling-block in the way of the universal introduction of meters and the general reconstruction of water and fire service rates.

The officials of many cities see the necessity of universal metering to save unnecessary expenditures in extensions and operation, but they do not see how they can curtail consumption and maintain the necessary revenue without resorting to some one of the numerous expedients which are variously used to create an unfair difference in favor of one or the other of their various classes of consumers, because in existing rates one or another class of consumer has been paying too little and will strenuously oppose an increase.

The Committee's tabulation shows a range of meter rates of from five to fifty cents per thousand gallons charged to small consumers, and from two to twenty cents per thousand gallons charged to large consumers; and even at fifty cents it is quite possible that some of

the small consumers are getting more service than they are paying for, and certain that others are getting very much less. Meantime, every flagrant overcharge of one class of consumer in one place is breeding discontent, and every flagrant undercharge of the same class of consumer in another place is encouraging that discontent, and the water works interests are being ground between the millstones of these discontents; and with the wide diversity of rates and of opinion as to the proper basis for rate making, as between different classes of consumers, including the tax payer, the ultimate fineness of the grinding of these millstones and the question of the availability of fuel to keep them turning, needs little comment.

It is fully recognized that existing laws, contracts, customs and conditions complicate every consideration of a rapid revolutionary change in any given case, and not only that each class of consumers whose pocket never would be touched will constitute an obstacle, but also that those who would be benefited will be suspicious and slow to recognize the benefit, and to lend their coöperation. For this reason, great educational work will be necessary, and the approach to better conditions will be slow.

The greatest opportunity for coöperation today, which is before the various water works associations, lies in the commanding position which a short, clear, comprehensible dedication of the general principles which should govern a proper division of the necessary total water revenue, as between the tax payer and the water rate payer, and as between the various rate payers, would hold; such a dedication could not bring all rates suddenly to the recommended basis, but it would tend to bring the coöperation of general public sentiment into play, and thereby cause all movements to be toward the general system recommended, and it would act as a buffer in the meantime for the company or city where some particular phase of its rate system is under fire, and really may be inequitable, to show exactly why such rate has to be charged, leaving the burden of defense of the too low charges which compose it, and which may be enjoyed by the small consumer, or the large consumer, or the tax payer as the case may be, to their beneficiary.

There have been many papers and discussions before this Association that bear upon various phases of this question, and there is a well established practice as to the determination of what con-

stitutes an efficient service, and as to how to arrive at a reasonable value. There is no great divergence of opinion as to what constitutes operation and maintenance expense, or fixed capital and depreciation charges, or a reasonable profit over and above these, and public service corporations nearly everywhere have to stand ready to show and defend their status in these respects, and are prepared with expert help to establish all of the things.

It is not, therefore, the question as to the total revenue which should be allowed, but rather the question as to how the payment of such revenue should be divided between the various classes of consumers, including the tax payer, which needs to be illuminated, regarding which, so long as the total profit is not reduced, the business departments of the water works fraternity will be in the strongest position if they lean toward a fair deal for every interest in its adjustment, leaving the parties who have the bills to pay to do a large part of the worrying.

The reports of your officers and of your standing and special committees are now to follow. Considerable time and study have been given to the preparation of these reports, and also of the various papers that are to be presented. In their discussion a great deal can be gained by an exchange of thought and experience, and I trust all will come forward and assist in the advancement of ideas for the solution of these many problems that confront the water works officials and superintendents.

Gentlemen, I thank you for your attention.

REPORT OF EXECUTIVE COMMITTEE

Your Executive Committee have received from members of the Association in the State of Iowa a formal request for the approval of this Association for the formation of a local section, to be known as the Iowa Section of the American Water Works Association; also a proposed constitution for the government of the Iowa Section when formed, and have approved both.

Your Executive Committee have also received an application in due form from twenty-four members of the Central States Water Works Association to form a local section, to include the following territory, viz.: Southern Michigan, Ohio, West Virginia, Kentucky and Pennsylvania west of and including McKean, Elk, Clearfield, Blair and Bedford Counties. Also presenting a proposed constitution for the government of the section when formed, both of which your committee approve.

In accordance with the recommendation of the Canvassing Board, appointed to canvass the vote for officers for the ensuing year, we recommend

the amendment to the constitution of the Association as suggested by the Canvassing Board, but with some modifications, making the amendment read as follows:

Substitute for the second paragraph of Section 3, Article VI, the following:

"The three members who shall have received the greatest number of nominating ballots for the office of President, the three members who shall have received the greatest number for Vice-President, the three members who shall have received the greatest number for Treasurer, and the six members who shall have received the greatest number for Trustee, shall thereby be placed in nomination; provided that no member shall be placed in nomination for more than one office; and provided further that no member shall be placed upon the ballot who shall have received less than twenty-five nominating ballots, and if there be a tie vote among the number required to be placed in nomination, an additional number of names to cover such tie shall be placed in nomination; any member who shall be nominated for more than one office shall have his name placed upon the ballot for that office for which he shall have received the highest number of nominating ballots."

Your Executive Committee have, also, received another amendment to the constitution changing the form and manner of election, signed by the requisite number of members and accordingly submit the same for your consideration.

The required number of members have presented a petition for an amendment to Article VI, Section 5, and to Article VIII, Section 1, which is also submitted for your consideration.

Your Executive Committee recommend the election of Mr. John Caulfield, an old time member and regular attendant at all of the conventions of the Association, of which he is a past president, to honorary membership.

GEORGE G. EARL, *President*
ROBERT J. THOMAS
NICHOLAS S. HILL, JR.
H. E. KEELER
CHAS. R. HENDERSON
JAMES M. CAIRD
LEONARD METCALF
THEODORE A. LEISEN
EDWARD BARTOW
DOW R. GWINN
J. M. DIVEN, *Secretary*

REPORT OF CANVASSING BOARD

TROY, N. Y., May 5, 1915.

Mr. George G. Earl, President,
American Water Works Association,
New Orleans, La.

Dear Sir: Your Canvassing Board appointed to canvass the votes for officers of the American Water Works Association for the ensuing year report as follows:

Total number of votes cast for President 590, as follows:		
Nicholas S. Hill, Jr	393	
Charles R. Henderson	50	
Allan W. Cuddeback	26	
Allen Hazen	121	
		590
Total number of votes cast for Vice-President 592, as follows:		
Leonard Metcalf	358	
Edward Bartow	153	
Theodore A. Leisen	81	
		592
Total number of votes cast for Treasurer 587, as follows:		
James M. Caird	401	
A. A. Reimer	38	
Rudolph Hering	84	
A. N. Talbot	54	
S. T. Powell	10	
		587
Total number of votes cast for Trustees 1113, as follows:		
Carleton E. Davis	389	
C. H. Rust	247	
F. C. Jordan	203	
H. M. Ely	107	
W. S. Cramer	57	
F. A. Barbour	110	
		1113

We find that, under the provisions of the constitution, literally interpreted, one name might appear on the ballot for several offices; also that names are placed on the election ballot that receive very few nominating votes, in some cases only one. We therefore suggest the following amendment to the constitution:

ART. VI, SECTION 3: Second paragraph, write "two" for "three," first line; ditto, second line, ditto, fourth line. Write "four" for "six" fifth line, making the paragraph read:

"The two members who shall have received the greatest number of nominating ballots for the office of President, the two members who shall have received the greatest number for Vice-President, the two members who shall have received the greatest number for Treasurer, and the four members who shall have received the greatest number for Trustees, shall thereby be placed in nomination." Add the following: "A third member shall also be placed in nomination for election to each of the offices of President, Vice-President, or Treasurer, and two additional members shall be placed in nomination for election as Trustees, provided that each of them shall have received a number of nominating votes equal to at least twenty per cent of the number received by the member for whom the greatest number of nominating votes shall have been cast for the same office; provided, however, that no name shall appear on the

election ballot for more than one office. If there be a tie vote among the number required to be placed in nomination, an additional number of names to cover such ties shall be placed in nomination." . . .

WM P. MASON
JAS. H. CALDWELL
J. M. DIVEN
Canvassing Board.

PRESIDENT EARL: Gentlemen, you have heard the announcement of the result of the ballot for election of officers for the ensuing year. The officers who received the necesssary number of votes as therein stated for the respective offices to which they were nominated are declared duly elected.

AMENDMENTS TO CONSTITUTION

Secretary Diven read the following proposed amendment:

Amend Article VI by striking out all of Section 3 and substituting therefor the following:

SECTION 3: On the third day of each annual convention, or on a day to be designated by the Executive Committee, the Convention shall elect a Nominating Committee, whose duty it shall be to suggest nominations for the officers of the association for whom there shall be a letter ballot of the membership. Said Nominating Committee shall consist of five Active, Honorary or Corporate Members, representing the following territorial distribution of the membership, to wit:

(1) The New England States, (2) The Middle States, (3) The Southern States, (4) The Central States, (5) The remainder of the United States, and all territory outside of the United States. The nomination for members of the Nominating Committee shall be made on the floor of the convention, first by placing in nomination of an Active, Honorary or Corporate member to represent the above geographical subdivisions who may be selected by the Active, Honorary or Corporate members from said geographical subdivision in attendance at the convention, and if such nomination is not so made, a nominee, representing any geographical subdivision failing to so submit a name, shall be made from the floor of the convention. The member of such nominating committee whose membership in the Association is the oldest shall be Chairman.

The Nominating Committee, so elected by the convention, shall cause to be mailed to the membership, within six months after the convention at which they are elected, a list of the nominees for the respective offices of the Association, for which the constitution provides there shall be a letter ballot of the membership. Up to within three months of the time of holding the next annual convention, additional nominations may be made by request to the Secretary, signed by at least twenty-five Active, Honorary or Corporate

members, and upon the receipt of such request, the Secretary shall add such additional nominees to the final ballot to be prepared by him. The nominees of the Nominating Committee shall head such final ballot for each office, and any additional nominees for the respective offices shall be placed under the nominees of the Committee in alphabetical order.

Amend Article VI, Section 4, by striking out the words "Twenty-one days" in the second sentence of the first paragraph of said section, and substituting therefor, "two months," so that this paragraph shall then read as follows:

"SECTION 4. Election shall be by letter ballot. At least two months before the date of the annual meeting, a ticket shall be mailed to each member of the Association entitled to vote."

Submitted by the following members:

MORRIS R. SHERRERD
THOMAS F. HALPIN
ALEX MILNE
J. WALTER ACKERMAN
F. W. CAPPELIN
E. E. DAVIS

The Secretary also read the following amendment proposed as a substitute for the suggestion of the Canvassing Board and recommended for adoption by the Executive Committee:

The three members who shall have received the greatest number of nominating ballots for the office of President, the three members who shall have received the greatest number for Vice-President, the three members who shall have received the greatest number for Treasurer, and the six members who shall have received the greatest number for Trustee, shall thereby be placed in nomination; provided that no member shall be placed in nomination for more than one office; and provided further that no member shall be placed upon the ballot who shall have received less than twenty-five nominating ballots, and if there be a tie vote among the number required to be placed in nomination, an additional number of names to cover such tie shall be placed in nomination; any member who shall be nominated for more than one office shall have his name placed upon the ballot for that office for which he shall have received the highest number of nominating ballots.

PRESIDENT EARL: What is the pleasure of the Convention in regard to the amendments to the Constitution, of which there are practically two before the Convention? Do you wish to vote on them at this time, or lay them over for further consideration?

MR. ROBERT J. THOMAS: I move that that amendment to the Constitution recommended by the Executive Committee be adopted.

The motion was seconded.

MR. MORRIS R. SHERRERD: It hardly seems fair to me that such a motion as that should prevail without consideration on both sides by the members; therefore, I would like to say a word on the relative advantages and disadvantages, to my mind, of those two methods. The difficulty about the method of procedure adopted during the last year is to my mind a difficulty which will be continuous by the adoption of the amendment suggested by the Executive Committee; that difficulty is that it necessitates in order to get any large number of votes for any candidate so proposed that somebody shall jockey around among the membership and suggest a ticket.

The amendment proposed by the Executive Committee would also make it possible that there would be no nominees for Trustees, as only names which received twenty per cent of the total ballot are to be placed on the ticket, as I heard the reading of those suggested amendments.

THE SECRETARY: Not twenty per cent, but twenty-five members.

MR. SHERRERD: I understood it twenty per cent.

SECRETARY DIVEN: That was the recommendation of the Can vassing Board. The recommendation of the Executive Committee was twenty-five votes.

MR. SHERRERD: There might happen to be some dozen candidates who might receive the nomination of their local sections which would make it very confusing, although the final ballot represented the distribution among the states that the Constitution provides, namely, there shall not be more than one Trustee from any one state.

I believe that this Association made a mistake when it departed as far as the present Constitution departs from the interest which has always been taken at the Convention in the selection of its officers. That is one of the features of the convention which has always been interesting, and it is one also which allows the membership from different parts of the country to get their heads together and make suggestions as to what tickets or what officers would be best for the interests of this Association; and it was with the idea of getting somewhat back to the former method of procedure that the amend-

ment was requested to be considered by six of us who have presented it for your consideration. It is difficult when an amendment such as the one just presented is read to grasp its scope. If you will pardon me, I will try and outline briefly what is intended to be accomplished.

The geographical subdivisions suggested are five, and from the membership located in those five subdivisions, and from the membership in attendance at the Convention from each one of those five sub-divisions, there would be a suggestion of a nominee to place before the Convention for a member of the Nominating Committee.

The sub-divisions suggested are the New England States, Middle States, Southern States, the Central States, and the rest of the United States and the territory outside of the United States, which would make five subdivisions geographically of the membership.

Say on the evening before a meeting at which nominations were to be made the representatives in attendance at the Convention from New England would meet in some committee room, and decide among themselves who their representatives on the Nominating Committee should be. On the next day some one of that delegation would make the nomination on the floor of the Convention that Mr. Thomas, for instance, had been selected as a representative on the Nominating Committee from those of us who were in attendance, and then move his nomination and the Convention would vote on his name. Now in a similar way the Middle States would suggest, we will say, Mr. J. Waldo Smith, and his name would be before the Convention as a member of the Nominating Committee; and in the same way other representatives from the different territorial distributions would be placed before the Convention, five names in all; and if the Convention elected those gentlemen as the Nominating Committee they would be probably here at the Convention and they would represent a distribution of the membership, and they would represent the opinion of five gentlemen who knowing the needs of the Association from the different standpoints throughout the country would be able to name gentlemen for officers, and present within six months thereafter a ticket to be voted on which would be the consensus of opinion as distributed throughout the entire territory in which the membership is located; and it would give that consideration to the subject which cannot be given by this haphazard method of having the total membership make sugges-

tions for nominations; and this amendment goes further, Mr. Chairman, to prevent from consideration any section, or any group of men from putting in nomination a candidate. Upon the request of any twenty-five members additional names, for any office, will be added to this ticket.

I hope that the motion now before you will not be favorably acted upon, because it at once shuts out consideration of the other amendment.

PRESIDENT EARL: Has any one else anything to say in regard to the question before the house?

MR. A. H. MEYERS, Columbia, Pa.: I am very glad to hear Mr. Sherrerd's suggestion. I got into the city this morning. I think I can speak for some of the members who are not very often heard on the floor of this Convention, men who are not identified with the actual management of the Association but who have its interest at heart. There seems to be a feeling that the present method of nomination of officers is not in touch with the membership at large, that it is practically a blind pool in which a man has no chance; and I think the suggestion made by Mr. Sherrerd will offer a little bit more of an opening for the smaller representatives.

MR. HATTON: This is a pretty serious matter, and I think we ought to have a few days before we would know how to vote upon the matter. I would suggest that action on the amendments be postponed until later in the Convention. I move that further action on this matter be postponed until Thursday of this week.

MR. CHESTER: I second the motion.

MR. HATTON: I suggest that some mimeograph copies be made so that we can digest them and we will know what they mean.

MR. SHERRERD: Is it worth while to put the question off? It seems to me that a motion calling for a vote on one or the other of these amendments might be considered. I do not want to say that the vote should be taken today on an important question like this.

PRESIDENT EARL: The amendment is before the house, gentlemen; what is your pleasure? All in favor of the amendment, which is to the effect that we postpone consideration and final action on these two proposed amendments until Thursday, and in the meantime that mimeographed copies of both amendments be distributed to the membership here, will please say, "aye," contrary, "no." The motion is carried, and it is so ordered.

POSTPONED DISCUSSION OF PROPOSED AMENDMENT

Thursday, May 13, 1915, 11 a.m.

The amendments having been distributed in mimeograph form to the members at the Convention, were now considered and further discussed.

MR. MORRIS R. SHERRERD: Since these have been distributed the members are pretty familiar with them, for the purpose of bringing the suggested amendments before the Convention, I move the adoption of the amendments providing for a Nominating Committee.

The motion was seconded.

PRESIDENT EARL: It is moved and seconded that the amendments proposed by Mr. Sherrerd, and others be adopted.

MR. MORRIS R. SHERRERD: I understand that it would leave the matter in the hands of the Executive Committee as to the day when nominations shall be made since the Executive Committee can, if the amendments suggested by those who have signed the request are adopted, direct that the nominations, in accordance with this new provision of the Constitution, be made this afternoon. It seems to me that this ought to be done, so that the matter does not go over for a year, because if the amendment is adopted, then it ought to be made operative at once. The question of making the nominations during the period of this Convention should be acted on so that final letter ballot for officers can go out under either form of the amendment which may be adopted for next year's nominations.

MR. THEODORE A. LEISEN: Would not that be amending the Constitution after this Convention? And would that be in accordance with the Constitution?

SECRETARY DIVEN: One amendment was brought up before the Executive Committee at this Convention, and it is in order.

MR. MORRIS R. SHERRERD: Both were, Mr. Secretary. They both stand in the same position.

PRESIDENT EARL: If there are no other suggestions, I suggest that the ballots be distributed and a vote be taken for the Sherrerd amendment, or for the Executive Committee's proposed amendment. I think that would be the proper way to designate them.

MR. MORRIS R. SHERRERD: Can't you call them one "Nominating Committee" and the other "Letter Ballot"—mark one "For Nominating Committee" and the other "For Letter Ballot?"

PRESIDENT EARL: Does any one desire to discuss the desirability of the amendments before they are voted upon?

MR. SEABURY G. POLLARD: I suggest that the gist of the amendments be stated, or that they be read. I think quite a number are not familiar with them.

MR. MORRIS R. SHERRERD: I would like to make clear the one suggested by those who have signed the request with me. It would give the five men who would be selected by the Convention as the representatives of the five districts designated, a chance to get together at the Convention and consider the best good of this Association in presenting a ticket which would be sent out to the membership as the Nominating Committee's ticket within six months after the Convention; and during the next three months additional nominees could be placed on the ticket, which would be prepared by the Secretary, upon request of twenty-five members; the Nominating Committee's candidates to head the list for each office, and any additional candidates to be added alphabetically. I would also like to say that the suggested amendment offered by the Executive Committee seems to me to lend itself to a situation which would be very awkward in connection with other parts of the Constitution.

The Executive Committee suggested an amendment providing that nominations shall be made upon letter ballot which is an indiscriminate way of getting at any concerted action.

The Constitution also provides that no two members of the Board of Trustees shall be from the same state. Under the operation of that suggested amendment you can see that it is quite possible that those who would receive the requisite number to be on the ticket, namely twenty-five votes, might mean two or three gentlemen possibly from the same state, and in that case there would be no nomination before the membership for those offices which would conform to the provision of the Constitution. You could not elect two of those gentlemen, because they would come from the same state and you would have no other name on the ticket to give concerted action.

I would also say that it seems to me an unfortunate way to leave the nominations of our officers to be jockeyed around by one or two individuals, as the method of indiscriminate selection does. It would be unfortunate, and would not give due consideration to the best interests of the Association.

It has also, in my judgment, taken away a very decided interest in the Conventions. A feature of the Convention program which is of interest to all of us, I think, is that there be a chance to have some consideration given as to who shall be our officers; and when it is done by letter ballot, as I have heard a number of men say, they had no particular choice or desire, they simply followed what was suggested to them; but if it were done by proposing names by the Nominating Committee, a plan which is easily workable, in other words, the method of procedure would be that representatives from New England who are in attendance at the Convention could agree to meet the night before the nominations are to be made, upon the request of some one that they meet in such and such a room to consider whom they should nominate, and the next morning some one gets up and says, "Our members from New England have agreed to suggest the name of Mr. ———— as our representative on the Nominating Committee"—and so on with the other sections, those that are here in attendance could select as a representative from their respective sections, a man who is here in attendance at the Convention, and then the gentlemen could get together before the Convention adjourns and discuss the matter, and then either by correspondence, or by agreement, send out a suggested ticket which would represent the consensus of opinion of, at least, five men who represented different sections of the country, as to who would best serve this Association as its officers.

I would, therefore, gentlemen, ask your favorable consideration of the amendment which would provide for a Nominating Committee.

PROF. EDWARD BARTOW: The present method, that we might call the "Primary" method, brings the Association before the members during the year; it keeps the Association before the membership because of the sending out of the letters requesting nominations, and it is rather a good thing to keep up interest between sessions. The present scheme should be continued for at least another year to give it a thorough trial.

A MEMBER: I just want to relate a little personal experience as to this ballot proposition, and state why I am heartily against it, and in favor of the Nominating Committee. The Nominating ballots were sent around, and I presume they went to all of the gentlemen. When I got them, I went to one very popular gentlemen and I said, "Who do you know that wants to be Trustee? Who do you know that wants to be Vice-President?" He could not tell and I did not know; and I dare say that ninety-five per cent of the members here either did not vote at all, or maybe some member voted for me, and I voted for another member, and somebody else voted for somebody else. A few people if they wanted to get together and vote for somebody, could keep the thing forever and forever. I am heartily in favor of this Nominating Committee proposition which provides that the members of that Committee be from the different districts of the country, which seems perfectly fair. If there can be any objection to it, I can not see it.

MR. A. A. REIMER: May I raise a question at this point in connection with the first amendment? The terms are very definite so far as defining the location of the New England States; but when we come to the Middle States, Southern States, and Central States, it seems to me that the line of demarcation is not quite so clearly drawn, and it might be well to have those other divisions definitely stated. Now a good many of us remember when we were in school that we had some divisions that we remember as "Middle Atlantic States," "Central States," and so on. That is a long while ago, and perhaps some of us do not remember just which states are embraced in those divisions. It seems to me that it might be well to define that particular point more clearly.

MR. C. E. DAVIS: I think it would be a good thing if the Executive Committee would name the particular states comprised in those respective districts.

MR. MORRIS R. SHERRERD: It seems to me that it can properly be left to the Executive Committee, to announce which states are included in each particular division. I understand that it is quite definitely understood what those divisions include.

MR. DOW R. GWINN: I did not expect to have anything to say on this subject; but as I understand, the motion is now on the amendment to the Constitution as proposed by Mr. Sherrerd; is that right?

PRESIDENT EARL: The vote is as between the amendment as proposed by Mr. Sherrerd for nomination by a Nominating Committee, or by letter ballot as recommended by the Executive Committee.

MR. DOW R. GWINN: When this matter was referred to the Executive Committee, we went over the report of the Canvassing Board and considered their recommendations very carefully

I would like to try out the constitution as we now have it, with the slight modification as recommended first by the Canvassing Board, and modified slightly and recommended by the Executive Committee. I believe that is the best proposition before us.

A MEMBER: One thing that has developed in this recent election is that we delegates, at least I for one, have received cards in the mail suggesting that I vote for this man, or that man. I received a card calling my attention to a man, and although I am quite a regular attendant at these Conventions, and have attended them for the last ten or fifteen years, one must have something by which he can remember a man, and remember whether he is a consulting engineer, or a water works man, or an active superintendent, or something of that kind—I believe I am going to say it out frankly—I have the highest regard for all of the consulting engineers, but I do not believe the Water Works Association here ought to have a majority, or practically all of the offices controlled by the professional end of it. I believe that the little fellows in the Associa-

tion ought to have, at least, a voice in the organization—that is the way I feel about it.

MR. C. W. WILES: I would like to inquire of the Secretary how many members of the Association cast their votes this year. That will give us some idea of how many took an interest in the election of the present officers at this time.

SECRETARY DIVEN: You mean votes for nominations?

MR. C. W. WILES: Yes, sir.

SECRETARY DIVEN: About twenty-five per cent. There were two hundred and forty-seven ballots cast.

MR. C. W. WILES: That shows the interest.

SECRETARY DIVEN: That was for the nominations. There were over six hundred votes cast for election of officers.

MR. J. WALDO SMITH: The criticisms about the old committees are fully covered by Mr. Sherrerd's amendment. I think we all agree with the last speaker, that the "little fellows" should have a chance, and this is just the way to give them a chance. By the present method we are just going at this blindly. It gives a certain class of men an opportunity that we do not want them to have, and I am heartily in favor of this change. We thought it was desirable when the change from the old method was made, which at its best was not a good one. I do not think the present method is very much of an improvement on the old one. I do think that what is proposed by Mr. Sherrerd would result in benefit to the Association.

MR. JERRY O'SHAUGHNESSY: I think Mr. Sherrerd's amendment improves the present method very much, but I do not think it is exactly what is wanted. We have wandered from the beaten path which leads to the election of officers and the place of holding our conventions. There is some reason for it. Somebody wants something done that would not do to let the common herd know about.

Yesterday, a gentleman from St. Louis asked me to vote for that city. I told him, "The cards are stacked, you have no chance; I will vote for St. Louis, for you, but it won't do any good." He said, "Yes, we have a chance." Thereupon I gave him some additional reasons as to why he had none. Afterwards, in the lobby of the hotel, he remarked, "You are a pretty wise old gazaboo."

It seems to me that a convention like this, composed of the class of men it is, that you can better judge from the assemblage who would be qualified to represent you as your officers than to have a nominating committee, or to have any other agency work for you and choose your place of convention or nominating or electing your officers. You men are certainly capable of attending to your own business; if not, you should not be here and somebody made a mistake in selecting you for the place you now hold.

I believe the amendment offered by Mr. Sherrerd comes nearer to the proper method of doing business than does the present one, but I would say further that it is my belief the day will come when the majority of the American Water Works Association will agree with me that it is better to attend to your own business and not delegate it to others.

Mr. George Houston: At the Louisville Convention I was inquiring as to who were the candidates for Trustees. I was given a list of names. Amongst them was Mr. Henderson. I immediately got myself acquainted with the different gentlemen who were candidates, and I said, "I want you to vote for Henderson as from what I learn he is the best qualified of any." Henderson was elected. What would I have known about the different candidates under our present system, or under the system proposed by Mr. Sherrerd? One of the main points of interest that I had in my early days attending the Convention was the opportunity that we were going to have to elect officers. You know we all like to vote, and we like to know if possible, the qualifications of the men we are going to vote for. I heartily agree with Mr. O'Shaughnessy that we ought not to adopt either one of these amendments to the Constitution, but that we ought to have another one that would enable us to go back to our original method, as he suggests, to make the nominations here on the floor and the elections here on the floor, then we will get somewhat near to what the great body of us really want.

MR. J. N. CHESTER: Mr. Chairman, I believe that Mr. Sherrerd's motion is the best that has been proposed here. I recognize all of the objections that have been brought up. It has been tried out in the American Society of Civil Engineers, and it has worked out fairly well. Mr. Sherrerd has, however, proposed an even better plan than that of the American Society of Civil Engineers. The natural result of any vote that is taken is that the congested districts are going to control if you give them the opportunity. Mr. Sherrerd's amendment distributes the members of the Committee into districts, and while I can not say that it absolutely disregards congestion, it does in a great measure, and that is what we must do. And I would add to it the rotation by districts of the Conventions. It goes without saying that the congested districts can always have a majority in this Convention, they can vote the Convention just where they see fit to put it. That is, of course, the majority rule, and we all say that it is right, but then it is not right for just a few big congested districts to divide the Conventions up and rotate them around between them.

I have no fault to find with the selections made. If too far away I stay at home; but I have heard a great many mutterings in the last few years about the way the Convention has been swayed. While the majority seem to prefer the big cities, we have our poorest Conventions in the big cities. It is a question whether we want to see sights or attend the Convention. If we add to Mr. Sherrerd's amendment a provision for rotating the Conventions, that they shall go from district to district, that it can not come back to a particular one until it has been to all of the rest, then I would like it a little better.

MR. MORRIS R. SHERRERD: That would naturally follow if this amendment is adopted; it does not follow as a matter of constitution, but it seems to me that that would be the logical thing.

MR. J. N. CHESTER: Let us make it a matter of constitution.

MR. MORRIS R. SHERRERD: It is not germane to this particular amendment.

MR. J. N. CHESTER: Well, I will add a clause compelling the Conventions to rotate by districts. If it is a good thing to send the

Conventions around over the country and get members in, why, let us do it.

SECRETARY DIVEN: That necessarily would be an amendment to another section of the Constitution. We could not add it to this section very well.

MR. THEODORE A. LEISEN: Without entering into the relative merits of the present and the suggested method of nominating, the speaker would like to point out that the amendment suggested by the Executive Committee, in reality is not a change in the intent or spirit of the present Constitution, but is merely a necessary correction to straighten out certain difficulties which have become apparent in connection with the nominating ballots; the specific difficulty which it is intended to remedy being the avoidance of having any one name placed on the final ballot for several different offices.

Under the wording of the Constitution, as it now stands, any one person might become a nominee for President, Vice-President, and for Treasurer and possibly also for a Trusteeship and the Committee would have no option but to place his name on the final ballot for all of these offices, and this is not considered wise or desirable. It was to get away from this difficulty that the amendment recommended by the Executive Committee was proposed. If the matter is to remain in abeyance for another year, or indefinitely, as the last motion provides, the speaker would suggest that in order to straighten out the difficulty mentioned, the amendment recommended by the Executive Committee had better be passed at this time and the Constitution can be revised later and the method of nominating officers changed as may seem best in the future.

PRESIDENT EARL: The question is on the original motion as made by Mr. Sherrerd for a vote as between the two methods—the method by Nominating Committee as recommended by Mr. Sherrerd and the signers on his petition, and the method by letter ballot, which is a continuation of the method described in the present Constitution, with the modification recommended by the Executive Committee. We will call for a standing vote. All in favor of the method of Nominating Committee will please rise.

A rising vote being taken as above, resulted in the vote of seventy-one in the affirmative, and a negative vote being called for, nobody rose.

SECRETARY DIVEN: In order to put this into effect there will have to be an election held during this Convention. I suggest that it be made a special order for five o'clock this afternoon.

PRESIDENT EARL: It will be made the special order for five o'clock. The gentlemen from each section will have to make arrangements to get together prior to that time, and they can introduce their nominees at five o'clock.

The undersigned propose the following amendments to the Constitution of the American Water Works Association:

ARTICLE VI: SECTION 5; Change to read: *Before the close of each annual convention, the executive committee elected to serve during the ensuing year shall organize and elect a secretary and an editor, to serve until the close of the next annual convention, or until their successors are chosen.*

ARTICLE VIII: SECTION 1: In the fourth line change the word "outgoing" to "incoming."

N. E. Bartlett
C. E. Davis
H. W. Streeter
W. R. Young
E. Wegman

THE SECRETARY: The Constitution as it now stands provides for the election of Secretary and Editor and the appointment of the Standing Committees by the outgoing Executive Committee; the object of this amendment is to change that to the new or incoming Executive Committee.

MR. THOMAS: Almost everybody will concede that the incoming officers ought to elect the officers that are to coöperate with them. I move that that last proposed amendment be adopted. I hope the motion will be adopted.

The motion was seconded.

MR. SHERRERD: I agree with Mr. Thomas. I hope the amendment will be adopted.

The question was now taken on the adoption of the last amendment, and the same carried.

MR. HENDERSON: I move that the recommendation of the Executive Committee that Mr. John Caulfield be made an honorary member be adopted. The motion carried unanimously.

MR. JOHN CAULFIELD, St. Paul, Minn.: Mr. President and Gentlemen, I certainly appreciate the honor conferred upon me by electing me to this high position. You have been more than kind to me since I joined the Association in 1887. This I think is the crowning honor which you have bestowed upon me. I remember the size of the Association and the small attendance that we had in those early days. I have attended the meetings for I think this will be the sixteenth consecutive year. I have enjoyed the meetings and I enjoy meeting the older members. That joy has been mixed with sadness as I note the annual decrease of our old members and reflect that there will be a time when probably a 1900 member will be considered an old member.

I thank you again for the honor.

PRESIDENT EARL: The next order of business is the report of the Secretary.

Secretary Diven then read his report on the state of the membership, as follows:

MEMBERSHIP

Active:				
Last report		923		
Elected to membership		220		
Restored		7	1150	
Losses: Died	7			
Resigned	16			
Dropped	98		121	1029
Corporate:				
Last report		68		
Elected to membership		9	77	
Losses: Resigned	2			
Dropped	5		7	70
Associate:				
Last report		122		
Elected to membership		19	141	
Losses: Resigned	11			
Dropped	7		18	123

Honorary:				
Last report		7		
Elected		1	8	
Losses: Died	1		1	7
Total Membership				1229

SECRETARY DIVEN: The change in the Constitution which changed the time that members should be carried from two years to one has had the effect during the past year of causing more members to be dropped than has ordinarily been the case; as under the old Constitution they would not have been dropped within three years.

IN MEMORIAM

HONORARY MEMBER

JOHN GALBRAITH.....Toronto, Ont.

ACTIVE MEMBERS

G. R. BROWN.....Missoula, Mont.
JAMES J. FERRIS.....Jersey City, N. J.
S. A. GAILEY.....Altoona, Pa.
EMIL KUICHLING.....New York, N. Y.
HENRY LAUTZ.....Pekin, Ill.
WALTER A. MCFARLAND.....Washington, D. C.
JOHN F. SPRENKEL.....York, Pa.

REPORT OF TREASURER

TROY, N. Y., April 1, 1915.

Mr. H. E. Keeler, Chairman Finance Committee, The American Water Works Association, Chicago, Ill.

Dear Sir: Permit me to submit my report as Treasurer of the American Water Works Association for the year ending March 31, 1915.

The funds of the Association are on deposit with the Troy Trust Co., Troy, N. Y., as per the order of your Committee.

The receipts during the year were as follows:

Balance April 1, 1914	$1,064.24
J. M. Diven, Secy.	10,683.84
Interest on deposit	88.57
Total	$11,836.65
Disbursements as per cancelled checks and collection charges	7,568.50
Balance, April 1, 1915	$4,268.15

The interest on the daily bank balance during the past year amounted to $88.57, which is $31.23 more than during the previous year.

Attached you will find certificate from the Troy Trust Co., showing a deposit of $4.279.50 at the close of business on March 31, 1915. From this balance there should be deducted the following unreturned checks.

Deposit as per certificate	$4,279.50
Unreturned check Voucher 578 ck. 746. Stowell & Son	11.35
Balance	$4,268.15

The cancelled checks and vouchers with the book of the Treasurer are submitted for audit.

Bank balance April 1, 1915	$4,268.15
Bank balance April 1, 1914	1,064.24
Increase	$3,203.91

The Treasurer is under $5,000 bond as per the order of your Committee. Permit me to suggest that the amount of this bond should be increased if such large deposits are to be maintained.

Respectfully submitted,
JAMES M. CAIRD.
TROY, N. Y., April 5, 1915.

This is to certify that the American Water Works Association had on deposit with the Troy Trust Company at the close of business March 31, 1915, the sum of Four thousand two hundred seventy-nine and 50/100 ($4279.50) dollars.

THE TROY TRUST CO.,
By Jas. H. Caldwell, *Chairman.*

REPORT OF FINANCE COMMITTEE

To the Executive Committee and Members of the American Water Works Association:

Gentlemen: Your Finance Committee beg to report that they have examined and audited the books of the Treasurer and Secretary and find them well and accurately kept.

Your Committee further find from the certificate of the President of the Bank, where the funds of the Association are kept, that the balance shown to be on hand by the Treasurer's report at close of the year ending March 31, 1915, is on deposit to the credit of the Association, and that all bills presented and certified for the year have been paid.

Authority has been given your Finance Committee, by the Executive Committee, to invest any surplus funds that, in their judgment, can be properly set aside, in municipal or state bonds and a beginning will be made at once to create a reserve fund in the hope that the Association may, in due time, have something to fall back upon in case of emergencies or unforeseen necessities.

Your Committee recommend that in the future all disbursements be governed entirely by funds appropriated for the various activities of the Association's work, and beg to submit the following for the year, beginning April 1, 1915.

There should be, and there is hereby appropriated out of any funds in the treasury of the Association:

For Convention purposes	$550.00
For Office and Postage purposes	650.00
For Election purposes	75.00
For Committee purposes	200.00
For Section purposes	500.00
For Office equipment	50.00
For Insurance	50.00
For Rents	150.00
For Salary of Secretary For Salary of Editor	1500.00
For Printing, distribution and all other charges incurred in publishing the Association *Journal*, except salary of Editor	5000.00
For Contingent expenses	500.00
	$9225.00

Moneys hereby appropriated shall not be transferred from one fund to another fund, and no indebtedness shall be incurred beyond the appropriation herein named for any particular purpose.

Your Committee, judging from past experience, believe that the amounts herein recommended are adequate, and within the resources of the Association.

Respectfully submitted,

H. E. KEELER
HOWARD DILL
H. B. MORGAN
Committee.

REPORT OF MEMBERSHIP COMMITTEE

MINNEAPOLIS, MINN., May 8, 1915.

Mr. President and Members of the American Water Works Association:

Your Membership Committee beg leave to report that the past year has been one of great growth not only in number but in prominence. The water works officials throughout the world together with the engineers, chemists, and bacteriologists have been seeking membership to such an extent that it seems to us it will be only a very short time before we can probably boast of a membership of at least 5000. During the past year 220 new members have been admitted to active membership from 33 states and 6 foreign countries as follows:

Alabama	1	New Jersey	8
Arkansas	1	New Hampshire	1
California	6	New York	20
Connecticut	5	North Carolina	1
District of Columbia	3	North Dakota	1
Florida	1	Ohio	18
Georgia	2	Oregon	1
Illinois	64	Pennsylvania	6
Indiana	2	Rhode Island	1
Iowa	10	Tennessee	4
Kansas	4	Texas	4
Kentucky	5	Virginia	1
Louisiana	1	Washington	4
Maine	1	Wisconsin	1
Maryland	4	Australia	4
Massachusetts	7	Canada	4
Michigan	6	Canal Zone	2
Minnesota	1	Hawaii	1
Missouri	10	Japan	1
Montana	1	Russia	2

At this time we wish to express the Committee's appreciation of the good work done by the members of the Association in getting so large an increase to our membership and especially to our faithful director, Mr. Edward Bartow, who has been instrumental in bringing to the Association eighty-seven new members, and we trust this work will be an incentive to all members and during the coming year the new Committee will find all our members looking out for new members and a great growth can be reported at the next Convention.

Thanking the officers of this Association for the courtesies extended to us and the members for their coöperation, we are

Very truly yours,

W. R. Young, *Chairman.*
Morris R. Sherrerd,
James H. Caldwell

REPORT OF PUBLICATION COMMITTEE

John W. Alvord, Chairman: The Publication Committee would like to request a little more time. There are several pretty serious questions coming up in the way of publications due to the amalgamation of new sections and the great volume of papers that are being presented, and the question with regard to the income from the advertising that has heretofore supported the printing of those papers by the local associations.

The Publication Committee are giving this matter serious con-

sideration, and wish the opportunity of meeting once or twice more during this convention.

PRESIDENT EARL: If there is no objection, the Publication Committee will be given further time for their report.

REPORT OF ELECTROLYSIS COMMITTEE

MR. DABNEY H. MAURY, Chairman: Mr. President, your Special Committee on Electrolysis find nothing which they wish to add to or change in their previous report.

REPORT OF COMMITTEE ON REVISION OF STANDARD SPECIFICATIONS FOR CAST IRON PIPE AND SPECIALS

The Secretary stated that Mr. John H. Gregory, Chairman of the Committee, was not able to be present, but had written reporting progress and asking that the Committee be continued to complete the work. The Committee are endeavoring to establish a standard that will be universal and have met with a similar committee of the New England Water Works Association and agreed on most points. The Committee have, also, had some correspondence with committees in Europe, one member of the Committee meeting with one such committee, to make a universal standard.

On motion of Mr. John Caulfield, duly seconded, the request of the Committee was granted and further time allowed to complete the work.

REPORT OF COMMITTEE ON STANDARD SPECIFICATIONS FOR WROUGHT IRON PIPE

MR. A. A. REIMER, Chairman: *Mr. President and Gentlemen:* Your Committee have been unable to get together at this Convention as yet.

The work has been carried on by the members, but it is a matter that will require a great deal of time. The research work necessary is something that can not be finished up in a month, or a year, or even in two or three years, because it requires the test of time. The Committee are short-handed at the present time. Mr. T. C. Hatton, resigned from the Committee owing to his removal and entrance into other lines. Mr. Emil Kuichling, of New York, died.

Your Committee wish at this time, if in order, to offer the following resolution:

Resolved: That the sympathy of this Association be extended to the family of Mr. Emil Kuichling; and that official recognition be taken at this time and in this way by an expression of the regrets of the Association at the loss of Mr. Kuichling, and that the Secretary be directed to forward such official regrets or notification of such official regrets to the family of the deceased.

Motion seconded by numerous members and carried unanimously.

REPORT OF COMMITTEE ON PREVENTION OF STREAM AND LAKE POLLUTION

To the American Water Works Association:

Through some inadvertence, the members of the Committee on Prevention of Stream and Lake Pollution were not notified of the composition of this Committee until just prior to this Convention and, in consequence, no regular meeting of the Committee has taken place and no report has been prepared in advance. This report is submitted in the nature of a progress report and is presented as the individual expression of the Chairman, owing to the fact that no meeting of the Committee has been possible.

Considerable preliminary and investigation work has been done by the United States Government through the International Boundaries Commission in the interests of suppressing the unnecessary pollution of the chain of lakes and rivers which form the boundary between United States and Canada, and while the efforts directed along these lines have been purely advisory, they have stimulated an interest in the subject which is productive of good results and have awakened an interest in the cities and towns along these waters, looking to the construction of such works as may be found necessary for the treatment of sewage in such a manner as will at least lessen the pollution of these streams and lakes. It has brought to the minds of the officials responsible for the welfare of the several communities, a fuller realization of their responsibility in this matter and as a result, investigations are being made by several cities preparatory to the installation of sewage treatment or sewage disposal plants. The comprehensive report issued by the International Boundaries Commission has furnished a lot of valuable information descriptive of the general condition existing at the present time, showing the degree of pollution at various points along the boundary waters.

Efforts along similar lines are now being directed to the Ohio River, from Cincinnati to Louisville, and possibly at some other points, but no reports have as yet been issued regarding this last work.

It would seem pertinent to suggest that the energies of the National Government might be directed along the same line as covered by the work of the International Boundaries Commission on investigation of various rivers throughout the United States, which of necessity carry off the sewage of large cities, and whose waters are required for municipal supplies at other points below where such sewage is turned in.

This, in a brief and concise way, embodies about all that the Committee can report at this time. It is a subject which it would seem should be followed up by this Association and the Association through the medium of a Committee, should endeavor to keep in close touch with the situation, and it is hoped that in another year the report of the Committee may embody a statement of practical results which have followed the work already accomplished.

It may be stated as a matter of interest, that along the line of preventing pollution, individual efforts have been made in addition to the advisory work of the Government, to induce the management of the various passenger vessels along the lake routes to provide facilities for holding the sewage on the boats, so that it can be emptied at points where the least possible harm can result, and also to provide facilities on each steamer for treating the sewage in some manner, even though it be crudely done, so as to further lessen the danger of pollution when the sewage is emptied into the stream. An effort along this line is being made in Detroit, and it may be stated with some degree of success, in that the owners of the vessels have indicated their willingness to provide facilities for treating the sewage, if proper and convenient methods can be indicated.

Respectfully submitted,

THEODORE A. LEISEN, *Chairman.*

On motion the report of the Committee was received as information and the Committee continued.

REPORT OF COMMITTEE ON STANDARD SPECIFICATIONS FOR HYDRANTS AND VALVES

MR. B. C. LITTLE, Chairman: The report is very brief, merely a report of progress. The Committee have been represented at several meetings through the presence of Mr. Diven and Mr. Caldwell. It is expected that the New England Water Works Association will adopt very soon their standard specifications for hydrants and valves. Possibly Mr. Diven will give a little further report as he has attended the meetings with the New England Water Works Association Committee. It will be well to continue this Committee for another year, at least, when we hope to add standard specifications for light weight valves, as well as reaching an agreement with the New England Association Committee.

MR. J. M. DIVEN: The standard specifications for hydrants and valves presented by this Committee have been adopted by this Association and are now in quite general use among the manufacturers. The Committee is only continued in an endeavor to make the standards adopted by this Association, or some modifications of those standards, a general standard. Members of your Committee met with a similar committee of the New England Water Works Association on two or three occasions, and came to an agreement on most points; after which the specifications formulated by the committee of the New England Association, with the concurrence of your Committee, were presented to the members of the New England Water Works Association, at a special meeting held in the city of Boston, April 15, 1914. With some modifications, asked for by the members of your Committee present at that meeting, the report was adopted, but three points requiring further consideration, which, owing to the changes made in the report at the meeting, were referred back to the Committee. Since that date your Committee have not heard from the committee of the New England Water Works Association concerning the points referred back, and no further action can be taken until they are heard from.

Meanwhile the standards adopted by this Association on report of your Committee are in active force and in quite general use by manufacturers. It is greatly to be regretted that the committees of the two leading water works associations cannot come to a final agreement and have a standard that all can use; but your Committee feel that they can do nothing further until action is taken on

the disputed points by the New England Water Works Association Committee.

MR. ROBERT J. THOMAS: We have one of the best Committees in the Association working on this subject. They are certainly trying to do all they can to carry out the recommendations of the President in regard to coöperation. The Committee have been very effective in their work with the like Committee of the New England Water Works Association; and no doubt at the next meeting of the New England Water Works Association our Committee will convince their Committee that our specifications are the proper ones to adopt, and that we will have, in regard to valves and hydrants at least, the same standard specifications.

Therefore, Mr. President, I move that the Committee's report be accepted as one of progress and that the Committee be continued.

Motion seconded and carried.

REPORT OF COMMITTEE ON WATER CONSUMPTION

MR. EDWARD S. COLE, Chairman: Mr. President, your Committee on Water Consumption presented their report, and it was printed in the March, 1915, *Journal* of the Association. Your Committee have tried, at least, to make a beginning towards the segregation of water consumption data; and we wish to express our appreciation of the reports received from water works officials. We have received, as the report shows, about one hundred and sixty-six reports from as many cities, and, as the diagram shows, the total consumption per capita has been plotted to a uniform scale. We have laid off the total meter registration for industrial purposes, and then we have laid off on the opposite end the total meter registration for domestic use; and in the space between, the white area, the unshaded portion represents the water unaccounted for through meters in those various cities.

Many cities make a very excellent showing, which seems to promise that more of this sort of segregation can be effected if we have more coöperation.

Our President in his address spoke of the advisability of standards, and your Committee feel that we are contributing a little in the line of standardizing the use of water for purposes of comparison.

Your Committee wish to make one suggestion, that is, that the well-known form of recording water works statistics adopted by the

New England Association should be amended by the addition of four columns giving the segregated uses of water by meter registration, being four classes of use that we have adopted and used in our report, namely, domestic, industrial, commercial and public.

With that suggestion, your Committee conclude their report.

MR. J. N. CHESTER, Member of Committee: Will emphasize Mr. Cole's remarks on this with just a little further suggestion as to how this work might be continued, not by this Committee, but as a permanent feature of our Association work. Some Committee on Forms, or Records, or Tabulation of Statistics might get to working on this, and the work be carried on in connection with a great deal of other work, and Mr. Cole's suggestion that the New England form simply be amended and adopted and put annually into the hands of each member of this Association be adopted. Some follow-up method might be adopted so that we could get a report from each member.

Now we have no complaint to make regarding responses that have been made to the requests sent out, having received something like one hundred and sixty-six replies; that, however, is a very small percentage of the number we were entitled to receive, had each member been as much interested in getting a report to us as we were interested in getting it from him. Our report would have been a great deal more useful to the members of this Association if it had been more complete, or had represented a larger number of the concerns or plants in the Association. But we appreciate, too, that records have not been kept in all cases. They are not going to be kept until there is some definite scheme provided whereby this information will be available. There is some data that have been obtained by the New England Water Works Association comprising a summing up of the annual reports of that district, which might well be added to our report. What little we have done and what information we have received have been of great benefit, more of it would be of more benefit. We are not going to ask that this Committee be continued, but move that a permanent Committee be appointed to standardize a form similar to the New England Water Works Association form, and that the consumption statistics be reduced to simpler elements, and be incorporated in that form.

The motion was seconded.

MR. WILLIAM J. HATTON: Before the motion is put, why control the Committee's action as to just what the form should be? Why not let it be phrased to allow the Committee to use some discretion? There may be other forms; there are some that the speaker would like to have the Committee take up; forms that would be very valuable in our work. Why not leave open the question of recommendation as to the form suggested by Mr. Chester instead of controlling the action of the Committee in submitting forms?

MR. J. N. CHESTER: It was not intended to hamper the Committee. The speaker is heartily in sympathy with the Committee having a free hand; but would like to have everything included that is in the New England blanks with reference to consumption statistics, at least, to have it include all the four divisions, so that we can find out how much of our water is not being accounted for at all, even though we have every tap metered. The speaker wants the Committee to have the broadest field, but not to complicate matters, so that if a blank is sent out the party getting it will think it so formidable that nobody will tackle it; that is one thing that we must guard against.

MR. J. WALTER ACKERMAN: In order to get unity of action, should not this Association formulate and its Committee present the same scheme for reports and accounts that has already been adopted and used, nearly identically, in the state of New Jersey by the Public Service Commission, by the Railroad Commission of Wisconsin, and by a number of other associations and bodies. These forms embody every feature which Mr. Chester desires.

MR. J. N. CHESTER: If the last speaker refers to the bookkeeping form, will not attempt to go into that matter at all; that is made up of a number of pages, whereas what we want to send out is something that could be compressed into one page. What is wanted is not bookkeeping forms, but an operating form that will show results for the year, and show it on a page or less; although consideration must be given to what the Public Service Commissions of the country are doing in the way of putting out forms, and our form must have relation to theirs.

SECRETARY DIVEN: Committee that Mr. Ackerman spoke of stopped a little bit short of getting up forms for making annual

reports. The Committee was continued with the idea that they would submit forms for reports to agree with the accounting system. If a new committee be formed for this purpose they should by all means take into consideration the accounting system that the Association has adopted.

MR. J. WALTER ACKERMAN: The speaker quite agrees with Mr. Chester that the form adopted must be as simple as possible, there is no doubt about that; but his remarks of a few minutes ago contained the key to the question exactly. He said that he realized that in a good many instances the plants have not the information to send to the Committee. Now the Committee referred to by the speaker provided a scheme for accounts that would give exactly the information that Mr. Chester desires.

MR. CHESTER: But it was too complicated to be put in use, there was too much of it.

SECRETARY DIVEN: Nevertheless the system has been approved by this Association and adopted by a number of public service commissions and water works, and any forms for annual reports adopted should conform to the system of accounts.

The Committee on Water Consumption have done good work and having the matter well in hand would be better able to handle the continuance of the work than a new committee; therefore move that the Committee be continued, without instructions, to prepare forms for reports.

PRESIDENT EARL: It is moved and seconded that this Committee on Water Consumption be continued, with full authority to get up such forms and data as they have suggested. Motion passed.

REPORT OF COMMITTEE ON STANDARD FITTINGS FOR WATER METERS

Two years ago a Committee was appointed, of which I have the honor to be Chairman, to revise the standards of meter lengths and meter connections.

This Committee did considerable correspondence with manufacturers and also among themselves during the first part of the year,

and at Philadelphia we were enabled to get the manufacturers together. We made a partial report at that time in regard to what we believed was the proper length to be established for these meters.

This year before this Convention was in session, the Committee made an effort to reach all of the manufacturers of meters. The manufacturers signified their willingness to meet this Committee here at this time, and we were very fortunate in having nearly all the manufacturers represented at this meeting.

While we did not arrive at a standard for all the meters, yet we did arrive at what we believed to be a better standard for the smaller sizes.

In the opinion of the Committee it was unnecessary to fix a standard for one-half inch meters, for five-eighth inch meters, or for one and a quarter inch meters, although we found from some manufacturers that there are some of the one and a quarter inch meters used.

In going over this matter with the manufacturers, the effort was to find some standard that would not interfere with present conditions either of the manufacturers or the users of these meters.

In fixing these sizes for lengths, which was the first matter to come up, and in going over the different lengths, we concluded after deliberation, that the length of the five-eighth inch meter from end of spud should be seven and three-eighths inches, but some of the manufacturers objected to this, and one manufacturer believed that it would be necessary to change his pattern to do this. This matter has not been fully investigated, and if it would be necessary for him to change his pattern, then seven and a half inches would probably be the length to be adopted.

In the three-quarter inch meter, they universally agreed that nine inches was the proper length.

On the one inch there was an agreement reached on ten inches and three-quarters.

Now as to the threads for these meters and couplings, the question was what thread would meet the present conditions.

After considering the matter, it was agreed that what was known as the Briggs standard straight thread would probably be more nearly universal than anything that we would establish to conform with what is being used. It was the sense of the Committee to use the Briggs standard straight thread using the next size larger than the size of the meter. For instance, with a three-quarter inch meter,

use Briggs one-inch thread, which is practically what we are using today. That is as far as they went into this matter.

This report that we are making today is only verbal. We hope to have a report fully prepared and have it printed in the *Proceedings* so that you may all have it for consideration between now and the meeting in New York, when, if there are any objections to the standards that we have suggested, or have used, they can there be discussed and finally acted upon.

In regard to the larger meters, the question arose as to whether they should be thread meters, with either male or female connections, or flange connections.

We found in discussing the matter with the manufacturers that the larger percentage of the one and a half inch, and the two inch meters that they sell, are sold with female threads, while the consensus of opinion of the Committee was that we would prefer to have a standard flange coupling, a 2-bolt coupling.

But it is not the intention of this Committee to interfere with the present conditions any more than is necessary, but to arrive at some fixed standard on which we can all agree to operate our plants. The intention of the Committee is to proceed further with this matter and prepare a standard set of specifications for these meters, adopting two different lengths, one for male connections and the other for flange connections. The objection raised by the manufacturers as to the adoption of the flange connections was that in making the flange on a meter they had to make it so heavy that it might be a burden on the producer of the meter. The trouble is that if these flanges are brought up parallel to each other, you can use a like flange on the meter, but if the meter should be a little out of line, you all probably have had experience in regard to the methods of the man who goes out to look after that meter. It is probably near dinner time when he is about to finish, and he does not want to lose any time, so he applies a wrench on the bolt and away goes the flange on the meter, and you have lost the bottom of that meter. Therefore you see the reason for the manufacturers insisting that they think it would be better to use on the one and a half inch and two inch meters, a female coupling rather than a flange coupling; but we hope at the next meeting that we will have this report prepared in full and have it published in the *Journal*, and in the meantime you can all have time to consider our recommendations, and if you have something better to offer, the Committee will be delighted to receive it.

In reference to these lengths of the larger meters, we have not changed our recommendations as to these lengths since last year, so that it will be unnecessary for me to go into this further.

Regret to say that the Committee are not prepared to offer you something for final acceptance or rejection; but almost all of you who have served on committees of this kind have experienced the difficulty of meeting all the conditions that surround a matter of this kind.

On motion of Mr. Diven, the above report was received and accepted, and the Committee continued until they conclude their work.

MR. MORRIS E. SHERRERD presented the following resolution:

WHEREAS, The operation and management of water plants are, or should be, conducted in the interest of their stockholders, which stockholders in the case of a municipally owned plant, are the water takers or inhabitants of such municipality, and

WHEREAS, The accounting methods prescribed for the public utilities by most, if not all of the Public Utilities Commissions of the various states require the charging of both sinking fund and depreciation against operation, and

WHEREAS, When the income from such utility is sufficient to provide for both sinking fund and depreciation, revenue which might otherwise justify a reduction of water rates, is by this method excluded from consideration in the making of such rates and

WHEREAS, It is not obligatory for private water companies to provide sinking funds for their bond issues, and earnings in excess of depreciation are distributed by them as dividends; and

WHEREAS, This method tends to place a municipally owned plant at a disadvantage and prevents its stockholders from getting their dividends in a reduction of rates;

Therefore, Be It Resolved: That it is the sense of the American Water Works Association, in convention assembled, that the attention of the Public Utilities Commissions of the various states be called to the inequalities resulting therefrom, and that they be requested to modify their requirements regarding this feature of accounting.

And Be It Further Resolved: That the Secretary is hereby instructed to forward a copy of this resolution to the various Public Utilities Commissions throughout the country.

MR. SHERRERD: I move the adoption of this resolution, Mr. President.

The motion was seconded.

MR. J. N. CHESTER: The whole matter is not stated in the resolution, wherein only the depreciation and sinking fund are mentioned. Every water works plant ought to make interest, depreciation and operating expense. The speaker does not believe in the sinking fund. It will not be fair to a profitably operated plant to eliminate the sinking fund and not mention interest; therefore, move to amend the resolution by including interest.

The amendment was seconded.

MR. SHERRERD: There is no objection to the inclusion of interest. It does not affect this resolution one way or the other. Interest is always to be charged against operation; there is no issue on that point. The only point to be brought out in this resolution is that the public accountants throughout the country have been heretofore so influenced by the managers of private plants that they have created a situation which dominates the public utilities commissions throughout the country. In other words, this resolution asks the Association to go on record as against establishing these methods in public plants. The method has been carried into the regulations that are applied by public utilities commissions.

To give you a concrete example in one city the plant has bonds outstanding to the extent of about $12,000,000, and there is now in the sinking fund in the neighborhood of $5,000,000 or $6,000,000 to pay off these bonds which will be paid off in 1922 under the rulings of the public utilities commission. Not only the interest, operation and depreciation, but also the sinking fund is charged against operation; so that it militates against that city's being able to adjust its water rates at this time and give its present water takers the benefit of a reduction; whereas in the natural course of affairs when those $8,500,000 in bonds are paid off from the sinking fund in 1922 there will be an opportunity to nearly cut the water rates in two for the benefit of the future.

The claim is that it ought to be so handled by utilities commissions that this adjustment of water rates can be given to the present water takers; in other words that the present generation ought not to pay the depreciation that will keep the plant up to the top notch and also pay the sinking fund that pays for the bonds. Of course at the end of the time they will not only have their plant by the charging of depreciation into operation, keeping it up to its highest efficiency, but they also will have paid for all their bonds,

during the same period of time, which does not seem to be a proper method of accounting to be applied by the public utilities commission. Also, that it does militate against a municipality in this way, that it prevents a municipality from giving to its stockholders the dividends that the private companies are able to give to theirs; while the private companies are taking advantage of this situation to say, "We will keep our rates up no matter what the municipality rate is." It gives them a chance to declare dividends, whereas the municipality can only complain against it to the citizens of the city.

After extended discussion which was taken part in by Messrs. J. N. Chester, C. B. Salmon, H. C. Hodgkins, Morris R. Sherrerd, Jerry O'Shaughnessy and Henry B. Morgan the resolution was on motion of Mr. Francis S. Luce, duly seconded, referred to the Executive Committee with instructions to report on it at the next annual Convention.

PRESIDENT EARL: We would like to hear a word from the newly elected officers. I will call on Mr. Nicholas S. Hill, Jr.

RESPONSE BY PRESIDENT-ELECT NICHOLAS S. HILL, JR., NEW YORK CITY

Mr. President and Members: I was congratulating myself that I was to escape this ordeal. Reminiscing seems to be the order of things this morning, particularly with Mr. John W. Hill.

As I look back to my earliest recollections of this Association, when I reflect upon the growth of the Association and the change in its spirit, when I see the increase in earnestness of purpose of those who attend the Conventions, and the improvements in the organization of the Association, I feel deeply the responsibility and the honor conferred upon any one who is connected with the office of president of an association which intimately touches the comfort and health of so large a portion of the population of this country. I am deeply indebted to the Association for the honor conferred upon me. All I can say is this, that I shall strive to do what I can to assist the progress of the Association during the coming year. (Applause.)

PRESIDENT EARL: I am deeply appreciative of the fact that Mr. Hill's election as President is most deserved, and I shall be very glad to see him assume the responsibilities that will fall upon him.

I congratulate the Association most sincerely upon its choice of President, and also upon its choice of Vice-President in the person of Mr. Metcalf, who I hope will say a word to you. (Applause.)

RESPONSE BY VICE-PRESIDENT-ELECT METCALF, BOSTON, MASS.

Mr. President and Gentlemen: I do feel deeply grateful to all of you for this expression of confidence in electing me as your next Vice-President. I shall take great pleasure in serving you and working with the other members of the Board. I have been very much struck, as I have gone about in this country, particularly in the last two years, the greater part of which I have spent in the Middle West and on the Pacific Coast, with the growing spirit of coöperation which has been referred to by our President, and of which evidence has been given in a great measure in different parts of the country of late.

I remember two or three years ago when Mr. Karl Imhoff, Chief Engineer of the Emscher District, Germany, first came to this country. He came to Boston with a letter of introduction to us from Mr. Herrick. He said to me that he was more impressed by the friendly spirit of coöperation amongst the engineers in this country than by anything else he had seen here. He said it was not true of Germany, indeed that consulting engineers as such did not exist in Germany, that their method of doing the work was quite different there; that a man was called to a city to do an important piece of work, did it, and then passed from that city to another; but that there were very few men in the country who had had experience in various cities who were in general practice. In England, too, the condition is quite different, and as a result of the method of conducting business there, there was not the cordial spirit which you find in this country. He said, "Why, I find in New York the engineers speak in a friendly way of their active competitors, if I may so speak of them, in Chicago, or in Boston, or in any other city in the United States." I replied to him that it was true that there was a radically different attitude on the part of engineers in this country from that which existed abroad. That is

true in like measure amongst the water works men; and I feel that we have made far greater advances in this country as the result of that spirit of coöperation.

In different sections of the country, of course, you find that not only the problems are different but that they have been met in different ways, so that getting together annually in conventions, as we do here, is of the greatest advantage in threshing out different ways in which similar problems may be handled.

In passing it is perhaps interesting to note the friendly spirit of rivalry which exists in some of these associations. Since I have been at this Convention here, probably because I am from New England, particularly at the Executive Committee meetings I have been asked again and again, when the New England Water Works Association would come into this Association as a section? I think that those of you have who attended the meeting this morning and heard the constant references to the doings of the New England Water Works Association must clearly realize the feeling which some of your superintendents who are members of that Association, have toward this Association; and I do not think that the spirit of rivalry which exists, or which has existed in some years between these two Associations is to the disadvantage of either. On the other hand, and behind all of that, you do see a very admirable spirit of cooperation between the two, and they are constantly being made to come together on standard specifications and that sort of thing, so as to improve the practice generally in this country.

To those of you who are seriously entertaining the hope that the two Associations may one of these days come together, I would point out that the New England Water Works Association has recently reciprocated the courtesy which was extended by this Association to it, to the members at least, of joining this Association without the payment of an initiation fee.

In conclusion, gentlemen, I thank you again for electing me as your Vice-President, and would say that I look forward with a great deal of pleasure to working with the new Board. (Applause.)

THE SECTIONS

NEW YORK SECTION

At a meeting of the Governing Committee of the New York Section, Mr. J. Waldo Smith was chosen President of the Section and Mr. Allen Hazen, Secretary.

It was decided to hold three meetings during the winter of 1915–1916, but exact dates for the meetings were not decided upon.

ILLINOIS SECTION

MINUTES OF THE FIRST REGULAR MEETING OF THE ILLINOIS SECTION OF THE AMERICAN WATER WORKS ASSOCIATION

The first regular meeting of the Illinois Section of the American Water Works Association, corresponding to the seventh regular meeting of the Illinois Water Supply Association, was called to order by President Ely March 9, 1915, in the lecture room of Engineering Hall at the University of Illinois.

President Ely delivered an address which was referred to a committee for recommendations. The Secretary-Treasurer's report was received and Messrs. Amsbary, Talbot and Gerber were appointed an Auditing Committee. They later reported that the accounts were correct.

PRESIDENT'S ADDRESS

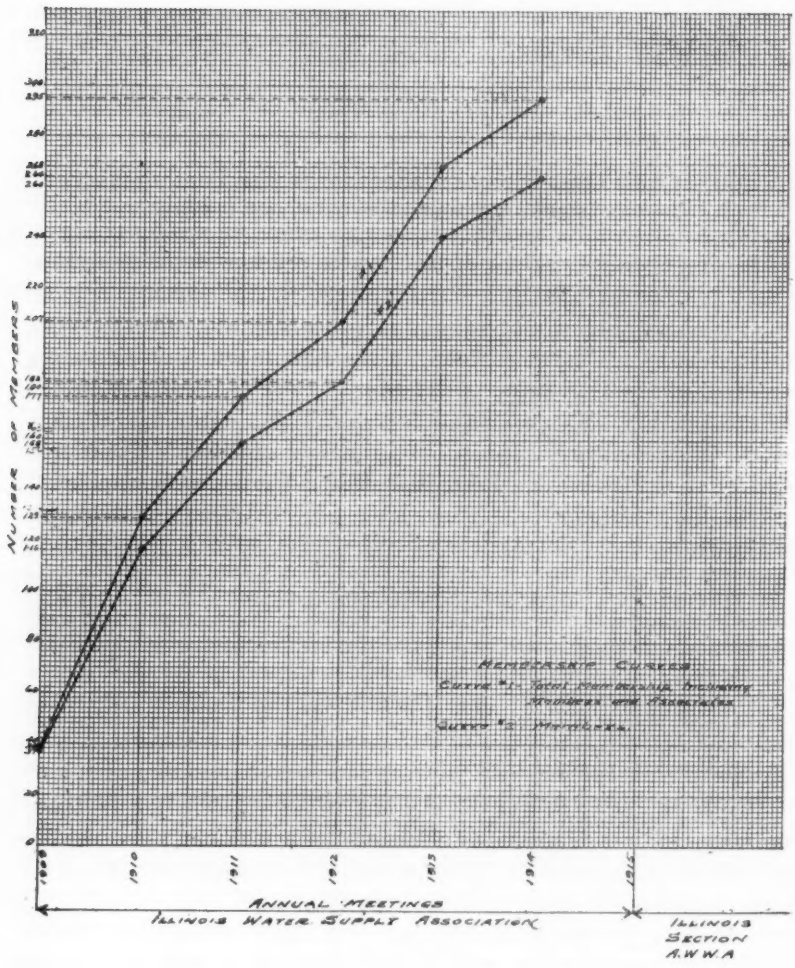
H. M. Ely

Superintendent Inter-state Water Company, Danville, Ill.

To the Members of the Association:

This is the seventh annual meeting of an organization of those interested in the advancement of knowledge concerning water supply and water works, and the purification and conservation of public water supplies throughout the state of Illinois.

In February, 1909, President James of the University of Illinois invited the water works men of the state to a conference with the State Water Survey concerning the important and vital question of the public water supply. At that conference a permanent organization was effected known as the Illinois Water Supply Association. This association under the able and energetic leadership of its secretary has grown in a very gratifying manner, not only from the standpoint of interest and benefit to the members, but also in point of increased membership. The growth in membership is best shown by the accompanying diagram, and shows an increase from 38, at the time of organization to 295 at the time of the 1914 meeting. The



lower curve represents the number of active members and the upper one the total membership including members and associates.

Referring to the address of Past President Cobb, the following may be quoted: "I think that the most important measure that we can adopt at the present meeting will be to become a section of the American Water Works Association." At the 1914 meeting the executive committee reported upon a proposition concerning amalgamation with the American Water Works Association, and recom-

mended that this question be submitted to a vote of all the members. Such a vote was later taken by letter ballot, with the result of 101 votes for the amalgamation to 11 against. On November 11, 1914 a special meeting was held in Chicago for the purpose of taking the necessary action for becoming a Section of the American Water Works Association. The proper action was taken and a petition presented to the national association. It is my great pleasure to announce officially that said petition has been granted and that our organization is now "The Illinois Section of the American Water Works Association" succeeding the Illinois Water Supply Association. Quoting again from the address of a past president, that of Mr. Parkin, "We believe that our association has found a permanent place among our state scientific associations." The speaker would call attention to the fact that we have not only found a permanent place among our state scientific associations, but have received recognition by a national organization.

This Association is a through passenger, having traveled over the rails of the Illinois Water Supply Association, has now come to a junction point, and without change of cars will proceed over the rails of the American Water Works Association. We will continue our meetings as heretofore, with consideration of subjects and problems existing under the local conditions in our own vicinity, comparatively speaking; will elect our own officers and the character of the meetings will not be changed. Let us put into the sectional organization the same interest and energy, and proceed with the same worthy purpose which has characterized the old association. We will give the above mentioned passenger an annual pass and expect him to report at least once a year, and perhaps again for an extra meeting. I think that the question of holding a one day meeting in the fall, of such character as our last November meeting, should be considered at this meeting.

I said put the same interest into the new organization; yes, I will say more interest. It is an advantage for us to be affiliated with the larger organization, and if that helps us we should be interested in the welfare of the parent association, and will be glad if the affiliation is of mutual advantage. It is believed that the sectional influence will be felt in the increase of membership of the national association. While it is too soon to judge definitely, consideration of the following facts seems to show that tendency. From a comparison of the membership in the American Water Works Associa-

tion for the years 1913 and 1914, according to states, it is seen that the increase in the state of New York is 32, New Jersey 17, Illinois 23, Pennsylvania 17, while the increase in the other states ranges from six to an actual decrease. New York and New Jersey combined to form the first sectional association, Illinois is the second. It will be noted these three states and Pennsylvania are the only ones in which there has been a noteworthy increase of membership. The increase in Pennsylvania is probably due to the holding of the Annual Convention in Philadelphia, but as to New York, New Jersey and Illinois, it is believed that the increase is due in a large measure to the sectional influence. The increase in 19 states is 127; the decrease in 14 states 28; no change in 16 states, leaving a net increase of 99 members in the American Water Works Association for year 1914. The fact that there was a decrease in 14 states, no change in 16 states, and only a small increase in the other states in which there are no sectional organizations, shows that there is a wide field for improvement in growth.

I believe that this movement, in which our own state is one of the pioneers, is spreading, and that many more states will see the mutual advantage in amalgamation, or in organizing sections in states where there is at present no state organization. Mr. W. R. Young, Registrar of the Minneapolis Water Department and Chairman of the Membership Committee of the American Water Works Association writes us that Minnesota is now organizing a state section. Mr. Young's letter reads as follows: "It gives me great pleasure to congratulate you on this work, and there is no doubt but that it will be one of the most prosperous state organizations affiliated with the parent branch."

We are informed that in Iowa there seems to be an unexpected demand among the water works men for such a society; that the organization of a state section is making steady progress; and that it is hoped to complete such organization and hold a meeting this spring. The Central States Water Works Association is considering the question of amalgamation, although no definite action has been taken as yet, but it is possible that that association may organize as three separate sections: Ohio, West Virginia and Michigan.

The speaker does not wish to convey the impression that our section is organized for the purpose of boosting the American Water Works Association. The wisdom of making this change has been passed upon by the association with the understanding that it does

not lose its identity; that we do not lose the benefits of our society, but gain by the connection with the national association. If by such action we benefit and strengthen the parent association so much the better for both the parent and the adopted child. This simile is not strictly applicable perhaps, for in the case of adoption of children, the same are dependent; the section organizations are not, or should not be; at least, ours is not. Your president also wishes to express his appreciation of the efforts and interest of the members and associates, for were it not for that interest, no secretary, however capable, could build up the association. The president desires also to thank the officers and committees for their efforts, and the members for their interest and attendance.

Let us hope that we may, and let us endeavor to continue under the new organization with the same spirit that has been shown heretofore, to the end that we may assist each other in our endeavors to faithfully and fairly serve our respective communities for the public good, that we may merit the same treatment by them.

FINAL REPORT OF THE SECRETARY OF THE ILLINOIS WATER SUPPLY ASSOCIATION AND FIRST REPORT OF ILLINOIS SECTION OF THE AMERICAN WATER WORKS ASSOCIATION

At the 1914 meeting the Association voted to appoint a Committee to present a statement to the members concerning affiliation with the American Water Works Association as a section. This report was submitted to letter ballot and the members voted in favor of becoming a section of the American Water Works Association. Accordingly a meeting was held in Chicago, an account of which was published in the March 1915 number of the JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION. The Executive Committee of the American Water Works Association have formed the Illinois Section of the American Water Works Association and have approved the constitution proposed by the special meeting held in Chicago.

Since the last meeting of the Illinois Water Supply Association the proceedings of that meeting have been edited and published. Fifteen hundred copies were printed, including 400 copies bound in cloth for members, associates and advertisers. Paper bound copies have been sent as exchanges to the Illinois Society of Engineers and Surveyors and the Indiana Sanitary and Water Supply Association. The proceedings of these associations were sent to members who had paid the 1914 dues prior to May 1. Owing to the affiliation with the American Water Works Association, exchange relations with the two organizations mentioned will be discontinued, and the papers presented at this and future meetings of the section will be sent to the Secretary of the American Water Works Association and after being approved by the Committee on Publications of the American Water Works Association, will be printed in their *Journal*.

The financial statement shows a balance of $223.12. This compares favorably with the balance of $120.66 a year ago. Since all dues are now paid to the American Water Works Association, the income of the Section will be confined to 25 per cent of the dues paid by active members, or $1.25 per member. A statement received from Secretary Diven of the American Water Works Association shows 105 active members on March 1. That would entitle us to draw for the coming year an amount not exceeding $131.25. This should be sufficient to pay the ordinary expenses of the Section as allowed by the constitution of the American Water Works Association.

The Secretary would suggest that the balance in the treasury together with any money which shall be received from back dues or sale of *Proceedings*, be held as a fund to pay for any special necessary expenses which should not be paid by the American Water Works Association, money to be paid from this fund on order of the President and Treasurer of the Illinois Section.

The Illinois Water Supply Association had in 1914 264 active and 31 associate members. Of these members, 178 resided in Illinois and 117 outside the state. Of these, outside of the state all but 29 have already joined the American Water Works Association. Of these, in the state 105 are now members, 7 have apparently satisfactory reasons for declining to transfer their membership and 66 have not yet been heard from. We should have an active membership of 150. The members of the Section should use every influence to increase the membership and make the Illinois Section a strong and powerful organization.

The report of the Publication Committee was given by Professor Talbot.

REPORT OF PUBLICATION COMMITTEE

In view of the fact that the JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION will be the medium for the publication of the *Proceedings* of the Illinois Section, the Publication Committee deem it proper to call attention to the value of the six volumes of *Proceedings* which have been published by the Illinois Water Supply Association as a contribution to the literature of water supplies and water supply engineering. The papers contained in these volumes are short crisp papers on a variety of subjects, and generally of a practical nature, along lines bearing on the quality of water supply and the construction and operation of water works plants. In thus calling attention to the material in the six volumes, the Committee wish to raise the question whether steps should not be taken to have the publication of the papers of the Illinois Section printed in the *Journal* in such a way, by notation and grouping, that the Section may be able to retain some individuality of publication. It is believed that such a form of publication would be helpful in assisting to maintain the high character of the programs of the meetings of the Illinois Section.

The March number of the *Journal* will contain the Constitution of the section. It is probable that the Constitution will be printed in pamphlet form. We recommend that a request be made to have a list of the charter members of the Illinois Section included in this pamphlet.

For another time, the Committee wish to call attention of the members to the valuable work of the Secretary, Dr. E. Bartow, in securing papers and in editing and printing the last *Proceedings* of the Illinois Water Supply Association.

Respectfully submitted,

A. N. TALBOT,
W. W. DEBERARD, } *Committee.*

H. E. Babbitt, Instructor in Municipal and Sanitary Engineering University of Illinois, read a paper entitled "Wash Water Salvage at Champaign and Urbana," which was discussed by Jennings, Mohlman and DeBerard.

W. F. Monfort, Consulting Chemist, St. Louis, Missouri, read a paper entitled "Relation Between Bacteriological Standards and Vital Statistics at Hannibal, Missouri." This was discussed by Bartow.

A paper by Langdon Pearse, Division Engineer, Sanitary District of Chicago, entitled "Loss of Head on Strainers of Water Filters," was read in his absence by the Secretary.

O. T. Smith, Superintendent and Manager Water Works Co., Freeport, Illinois, read a paper entitled "Experiences in Rebuilding and Reinforcing a Water Works System." This was discussed by Brandli, Smith, McGonigale, Reid, Roos, Allen and Strasser.

R. R. Parkin, Chief Engineer Water Department, Elgin, Illinois, read a paper entitled "Experiences with Artesian Well Water at Elgin." Adjourned.

An illustrated paper by Cass L. Kennicott, Vice-President and General Manager the Kennicott Co., Chicago, entitled "Soft Water," was read by Mr. Dunham.

Moving pictures showing coal mining operations, films obtained through the courtesy of the Bureau of Mines, were presented by Prof. H. H. Stoek of the University.

F. H. Kay, Assistant State Geologist of Illinois, read an illustrated paper entitled "Coal Resources of the Danville Area." This paper will be published by the State Geological Survey.

Frank DeWolf, Director Illinois State Geological Survey, read an illustrated paper entitled "Investigation of Artesian Water Supplies in the Chicago Area."

W. R. Gelston, Superintendent Citizens' Water Works Co., Quincy, read an illustrated paper entitled "The New Filtration Plant at

Quincy, Illinois." This was discussed by Langelier and Babbitt. Adjourned.

The third session was called to order at 10 a.m., Wednesday, March 10, 1915.

W. W. DeBerard, Western Editor, *Engineering Record*, Chicago, read a paper entitled "Kinks in the Control of Hypochlorite at Denver." It was discussed by Jennings and H. E. Jordan.

L. A. Fritze, City Chemist, Moline, Illinois, read a paper entitled "River Sand as a Filter Medium." Discussed by Amsbary, DeBerard and Ely.

S. C. Hadden, Associate Editor, *Engineering and Contracting*, Chicago, read a paper entitled "The Practical Value of Publicity to the Water Works Man." It was discussed by Gwinn and Hansen.

C. B. Williams, Hydraulic and Sanitary Engineer, Chicago, read a paper entitled "The Possibilities of Improved Water from Deep Wells in Northern Illinois."

A. N. Bennett, Assistant Chemist, State Water Survey, Urbana, and Edward Bartow, Director State Water Survey, Urbana, Illinois, read a paper entitled "Arsenic in Filter Alum." It was discussed by Graham.

C. A. Jennings, Chemist and Superintendent of Filtration, Union Stock Yards, Chicago, read a paper entitled "Bubbly Creek Filter Plant Adopts Liquid Chlorine Treatment."

Officers were elected as follows:

Chairman: W. J. Spaulding, Commissioner of Public Property, Springfield.

Vice-Chairman: Paul Hansen, Engineer State Water Survey, Urbana.

Treasurer: H. E. Keeler, The Rookery, Chicago.

Trustee to serve 3 years: F. C. Amsbary, Superintendent and Manager Champaign and Urbana Water Company, Champaign.

Edward Bartow was later elected Secretary by the Executive Committee.

The Committee on the President's Address reported as follows:

Your Committee appointed to consider the recommendations contained in the President's address report as follows: We believe that it is desirable to hold a one day's meeting early in October each year, the time and place to be decided by the Executive Committee. We suggest that the type of meeting

held in the fall of 1914 at Chicago is a good example of the character of meetings to which these may well conform.

WILLIAM T. BARNES,
A. N. TALBOT,
S. C. HADDEN.

BOARD OF TRUSTEES

Resolved: That all funds and other property of the Illinois Water Supply Association be placed in the hands of five trustees. These trustees in the first place shall be named by President H. M. Ely, but the Trustees acting at any time shall have power to fill vacancies caused by death, resignation, or otherwise. The Trustees shall have authority to expend and dispose of the aforesaid funds and other property according to their judgment and for the benefit of those who were members of the Illinois Water Supply Association or who shall be members of the Illinois Section of the American Water Works Association.

Resolution seconded and adopted.

President Ely appointed as the first Board of Trustees the following named, viz:

Messrs. H. E. Keeler, F. C. Amsbary, A. N. Talbot, W. D. Gerber and Edward Bartow.

Mr. C. M. Larson, Chief Engineer, Railroad Commission of Wisconsin, Madison, Wisconsin, read a paper entitled "State Regulation of Municipally Owned Plants."

C. G. Bennett, Mechanical Engineer, Illinois Utilities Commission, Springfield, read a paper entitled "The Illinois Utilities Commission and the Water Works Companies."

Douglas A. Graham, Principal Assistant Engineer, Dabney H. Maury, Chicago, read a paper entitled "The Application of the Theories of Regulation to the Management of Utilities."

Ralph E. Heilman, Assistant Professor of Economics, University of Illinois, read a paper entitled "Economic Aspects of Water Works Operation."

Edward A. Pratt, President Edward A. Pratt Audit Co., Peoria, read a paper entitled "Ancient and Modern Accounting for Utilities."

The following papers by authors who were not present were read by title:

"The Design and Operation of Intermittently Operated Water Purification Plants," by N. T. Veach, with Worley and Black, Consulting Engineers, Kansas City, Missouri.

"Cooled Drinking Water" by R. F. Massa, Manager, General Refrigerator Machine Department, H. W. Johns-Manville Co., Ft. Wayne, Indiana.

"The New Filtration Plant at Decatur, Illinois" (Illustrated), by Harry Ruthrauff, Commissioner of Public Property, Decatur.

"Choice of Alloys in Connection with Water Works Equipment," by Horace Carpenter, Engineer, Sanitary District of Chicago.

"Treatment of Water for Locomotive Use," by W. A. Pownall, Water Engineer, Wabash Railway, Decatur.

"Water Supply of Longview, Texas," by Paul E. Green, Civil and Sanitary Engineer, Chicago.

"Some Features of the Ontario Statutes and their Administration Affecting Water Supply and Sewerage," by F. A. Dallyn, Provincial Sanitary Engineer, Toronto.

"Water Prevention by Individual Meter versus District Meters," by R. O. Wynne-Roberts, Consulting Engineer, Regina, Sask.

The President was authorized to appoint a Legislative Committee together with other committees which might be necessary for carrying on the business of the Section.

Adjourned.

On March 11, the members visited Danville, Illinois, and inspected the stripping mine of Two Rivers Coal Co., the shaft mine of the Bunsen Coal Co. and the Danville Water Works. They were entertained at luncheon by the Interstate Water Co. of Danville.

IOWA SECTION

April 27, 1915.

To the Executive Committee of the American Water Works Association:

The twenty-eight men whose names are listed below have all applied for charter membership in an Iowa Section of the American Water Works Association. A copy of the constitution to which they have all agreed is attached to this formal application for a charter. All but five of these men are at present members of the American Water Works Association. These five men have agreed to apply for membership immediately upon the granting of a charter to the section. Indeed, two of the men, Mr. Judd and Dr. Albert, have already applied for membership. We believe that the formation of an Iowa Section will greatly advance the water works interests of the state. If the charter is granted, we hope to hold our first meeting for the election of officers and for the presenting of papers during the first week in June.

C. H. Streeter, Cedar Falls, Iowa; W. A. Judd, Mason City, Iowa; L. H. Goebel, Cedar Rapids, Iowa; Wm. Molis, Muscatine, Iowa; John W. Pray, Fort Dodge, Iowa; Jack J. Hinman, Jr., Iowa City, Iowa; Dr. C. S. Woods,

Iowa City, Iowa; Dr. Henry Albert, Iowa City, Iowa; W. A. Hostetler, Iowa City, Iowa; J. H. Dunlap, Iowa City, Iowa; K. C. Kastberg, Boone, Iowa; B. J. Stedman, Dubuque, Iowa; C. N. Kinney, Des Moines, Iowa; J. P. Berry, Waterloo, Iowa; Charles J. Fox, Oskaloosa, Iowa; Francis D. H. Lawlor, Burlington, Iowa; James P. Donahue, Davenport, Iowa; Horace A. Brown, Ottumwa, Iowa; Mr. Wm. Coppock, Council Bluffs, Iowa; J. Chris Jensen, Council Bluffs, Iowa; Henry M. Hanssen, Carroll, Iowa; M. I. Evinger, Ames, Iowa; G. E. Shoemaker, Waterloo, Iowa; B. N. Kinnaird, Des Moines, Iowa; Charles R. Henderson, Davenport, Iowa; Thomas N. Hooper, Davenport, Iowa; J. E. Roberts, Corning, Iowa; David Fisher, Davenport, Iowa.

A local committee of ten members has been in charge of the preliminary work for this Section. This Committee consists of the following men:

J. H. Dunlap, Iowa City, Chairman; C. H. Streeter, Cedar Falls; John W. Pray, Fort Dodge; L. H. Goebel, Cedar Rapids; W. A. Judd, Mason City; M. I. Evinger, Ames, Iowa; William Molis, Muscatine, Iowa; J. P. Berry, Waterloo; Dr. C. S. Woods, Iowa City; O. E. Klingaman, Iowa City.

Respectfully submitted,

J. H. DUNLAP, *Chairman.*

CONSTITUTION OF THE IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION

ARTICLE I

Name

The name of this society shall be "The Iowa Section of the American Water Works Association."

ARTICLE II

Object

The object of this Section shall be the same as that of the American Water Works Association, namely, "the advancement of knowledge of the design, construction, operation and management of water works, and the encouragement, by social intercourse among its members, of a friendly exchange of information and experience."

ARTICLE III

Headquarters

The headquarters of this section shall be at the State University of Iowa, Iowa City, Iowa.

ARTICLE IV

Membership

The membership shall consist of the members of the American Water Works Association residing in the State of Iowa.

ARTICLE V

Officers

SECTION 1. The officers of the Section shall be a Chairman, Vice-Chairman, Secretary-Treasurer, and two directors. These officers shall constitute an Executive Committee, of which the Chairman of the Section shall be Chairman and the Secretary-Treasurer shall be Secretary.

SECTION 2. The officers and directors shall be elected at the time of the annual meeting to hold office for one year. The Secretary-Treasurer shall be elected annually by the Executive Committee. Vacancies in the list of officers occurring during the year shall be filled by appointment by the Executive Committee.

SECTION 3. The Treasurer shall perform the duties required under Section 4, Article X, of the American Water Works Association.

ARTICLE VI

Meetings

SECTION 1. The meetings shall be held annually at such time as shall be ordered by the Executive Committee. The place of meeting shall be the University of Iowa, Iowa City, Iowa, unless otherwise ordered by the Executive Committee.

SECTION 2. Special meetings may be called by the Executive Committee or upon written request of fifteen members of the Section.

SECTION 3. Ten members shall constitute a quorum for the transaction of business.

ARTICLE VII

Constitution of the American Water Works Association

The Constitution and By-Laws of the American Water Works Association, to the extent to which they are applicable, shall govern the transaction of the business of the Iowa Section, but no rules or by-laws of this section shall be inconsistent with the Constitution and By-Laws of the American Water Works Association.

ARTICLE VIII

Amendments

The Constitution may be amended by a two-thirds vote of the members present and voting at any annual meeting of the Section. Such amendment shall be in effect after approval by the Executive Committee of the American Water Works Association.

The application of the Iowa members to form a section was approved by the Executive Committee of the American Water Works Association and the constitution of the new section was also approved by the Executive Committee.

CENTRAL STATES SECTION

CINCINNATI, OHIO, May 10, 1915.

To Executive Committee American Water Works Association.

Gentlemen: The undersigned Active or Corporate Members of the Central States Water Works Association residing in the territory below named respectfully request authority to form a local section of the American Water Works Association.

The territory to be included in this Section to be as follows: Southern Michigan, Ohio, West Virginia, Kentucky, and Pennsylvania west of and including McKean, Elk, Clearfield, Blair and Bedford counties, Pennsylvania.

We submit herewith a copy of the Constitution and by-Laws for the government of the proposed section for your approval:

F. W. COLLINS	S. F. MESSER	R. P. BRICKER
W. C. DAVISSON	WILLIAM FLEIG	GEORGE J. FISHER
F. B. LEOPOLD	E. FORD	H. J. PUTNAM
L. A. TONKEL	JAMES WILKINSON	ROY A. HOBBS
CHARLES BENNETT	W. J. SCROGGINS	W. C. MESSER
W. C. WILES	WILLIAM JUNKINS	J. C. MARTIN
A. W. INMAN	W. F. SCHICKLER	C. J. SMITH
A. W. CARPENTER	M. J. BREECE	WILLIAM BRUCK

CONSTITUTION AND BY-LAWS OF THE CENTRAL STATES SECTION OF THE AMERICAN WATER WORKS ASSOCIATION

ARTICLE I

This Association shall be known as the "Central States Section of the American Water Works Association" succeeding the "Central States Water Works Association."

ARTICLE II

The object of this organization shall be the same as that of the American Water Works Association, namely "The advancement of knowledge of the design, construction, operation and management of water works, and the encouragement, by social intercourse among its members, of a friendly exchange of information and experience."

ARTICLE III

The headquarters of the Section shall be at such place as may be designated by the Executive Committee of said Section.

ARTICLE IV

The membership shall consist of the members of the American Water Works Association residing in the following territory: Southern Michigan, Ohio, West Virginia, Kentucky, and Pennsylvania west of and including McKean, Elk, Clearfield, Blair and Bedford counties.

ARTICLE V

SECTION 1. The officers of the Section shall be Chairman, Vice-Chairman, Secretary, Treasurer, and four Trustees, who shall perform the duties usually incumbent upon such officers. These officers shall constitute an Executive Committee. These officers except the Trustees shall hold office for one year, the Trustees for two years, but upon the first election subsequent to the adoption of this Constitution two Trustees to be elected for one year and two for two years, and thereafter two to be elected annually to serve for two years, or until their successors are elected and qualified. Vacancies in the list of officers may be filled by the Executive Committee.

SECTION 2. At least thirty days before each annual meeting of the Section, the Secretary shall mail to each active, corporate, or honorary member a blank upon which the member may express his choice for Chairman, Vice-Chairman, Treasurer and two Trustees. The Secretary, in conjunction with two other members appointed by the Chairman, shall count all nominating ballots before the date of the annual meeting. The three members who shall have received the greatest number of nominating ballots for each office shall be voted on by ballot by the members present at the annual meeting. The Secretary shall be appointed by the Executive Committee.

SECTION 3. The Treasurer shall submit all bills to the Chairman of the Section before payment and shall perform the duties required under Section IV, Article X, of the Constitution of the American Water Works Association, as follows: "Each Local Section may receive from the Treasurer of the Association, for local use, not more than 25 per cent of the annual dues paid to the Association by the members of said Local Section. The Treasurer of said Local Section shall forward to the Secretary of the Association his application indorsed by the presiding officer of the Section for such portion of said sum as may be needed; and upon receipt of such application the Secretary shall request the Finance Committee to authorize the Treasurer of the Association to pay such sum to the Treasurer of the Local Section. Said sum may be used by the Local Section only in the payment of necessary operating expenses incurred by the Section, such as printing, stationery, postage, rent and care of room, light, fuel, etc. At the end of each fiscal year the Treasurer of each Local Section shall certify to the Secretary of the Association the balance on hand of the funds from the Association. This balance shall be returned to the Association or shall be charged to the Local Section as a portion of its quota for the following year. The Local Section shall not be entitled to draw upon the Association until such certification has been made and its accounts audited by the Finance Committee.

SECTION 4. Twenty members shall constitute a quorum for the transaction of business.

SECTION 5. At the regular meetings of the Section the business shall be conducted in the following order:

Reading of minutes; reports of officers; reports of committees; miscellaneous business; announcements; reading of papers and discussion; adjournment.

ARTICLE VI

SECTION 1. The meetings shall be held annually at time and place as designated by the members present at previous annual meeting, but the Executive Committee shall have power to change the place of meeting, if in their judgment it seems desirable to do so, provided that such action be taken by unanimous vote of the Executive Committee.

SECTION 2. Special meetings may be called by the Executive Committee or upon written request of twenty-five members in good standing. In case of such a special meeting the object shall be definitely stated and no other business shall be transacted.

ARTICLE VII

No rules or by-laws of this Section shall be inconsistent with the Constitution and By-laws of the American Water Works Association.

ARTICLE VIII

The Constitution and By-laws may be amended by a two-thirds vote of those present and entitled to vote at any regular meeting of the Section provided twenty-four hours' notice shall have been given in convention by not less than five members in good standing. Such amendments shall be in effect after approval by the Executive Committee of the American Water Works Association.

The application of the members of the Central States Water Works Association to form a section of the American Water Works Association was approved by the Executive Committee of the American Water Works Association and the constitution proposed for the government of the section was approved.

CHEMICAL AND BACTERIOLOGICAL SECTION

FIRST SESSION

Thursday Morning, May 13, 1915

The first session of the Chemical and Bacteriological Section was held at 9.30 a.m., Thursday, May 13, 1915, at the Hotel Gibson, Cincinnati, Ohio, Mr. W. F. Monfort, presiding. There were about fifty members present.

CHAIRMAN MONFORT: The meeting will come to order. We will listen to the minutes of the last meeting.

SECRETARY KIENLE: The meeting of the Chemical and Bacteriological Section was held at the Bellevue-Stratford at the last session

of the American Water Works Association Convention held at Philadelphia, May 14. Resumé of the previous meeting at Minneapolis was read. The Secretary stated the work done during the year, followed by statements from Professors Bartow and Monfort of the objects of the Section.

There was some discussion of the separate meeting question—that is to say, holding the separate meeting independent of the main body of the Association; also the by-laws of the Section.

After that a motion was offered by Mr. Bartow, that the Chairman or Secretary ask the Executive Committee of the main organization to set aside one day at the next convention for the holding of an independent Section Meeting. This motion was passed.

The question of by-laws for the Section was discussed but no definite action was taken.

A motion was carried for the election of a committee to act as the Executive Committee of the Section for the ensuing year, also to prepare by-laws for the Section.

The following named were nominated and elected as such committee, viz: Wilson F. Monfort, Francis D. West, M. B. Litch, S. T. Powell and John A. Kienle.

The election of officers of the Chemical and Bacteriological Section resulted as follows:

President: Mr. M. B. Litch, Superintendent and Chemist Filtration Plant, Steelton, Pa.; Secretary: Mr. John A. Kienle, 25 Madison Avenue, New York City; Executive Committee: Mr. Paul Hansen, Engineer State Water Survey, Urbana, Ill.; Dr. Wade H. Frost, U. S. Public Health Service, Cincinnati, O.; Mr. Charles P. Hoover, Chemist Filtration Plant, Columbus, Ohio.

DISCUSSION

MAINTENANCE OF THE WATER SUPPLY DISTRIBUTION SYSTEM OF NEW YORK CITY[1]

Mr. Fred B. Nelson: The scope of the subject which Mr. Brush has covered necessarily forbids his taking up in detail any one of the small divisions of the many that make up the total mainte-

[1] A paper by Mr. William W. Brush read at the meeting of the New York Section of the American Water Works Association, December 3, 1914, and published in Vol. 2, No. 1 of the Journal of the Association at p. 206, etc.

nance work of the New York Water Department. It may therefore be that a few features of the underground waste detection work bearing directly upon the subject of maintenance may be of interest, principal reference being given to the Boroughs of Manhattan and the Bronx, which consume roughly two-thirds of the 500,000,000 gallons per day supplied to the greater city, also the development and continuance of a large leakage is especially favored in these two Boroughs by sub-surface conditions. The original rock surface in Manhattan and the Bronx has been blasted out for street grading, basements of buildings, sub-way construction, etc., and much of the excavated loose rock used as fill in bringing low areas up to grade. Many of the sewers are in rock excavation and street mains and service pipes are frequently laid in the sewer trenches.

The saving in the two Boroughs has in the past four years totalled 33,000,000 gallons per day, which includes some 217 individual leaks, the size of which range in gallons per day as follows:

Ten leaks were from 500,000 to 4,000,000 g.p.d. and averaged 1.4 million gallons per day.

Forty-six or 21 per cent were from 100,000 to 500,000 g.p.d. averaging 200,000 g.p.d. and 161 or 75 per cent were below 100,000 g.p.d. and averaged 60,000 gallons.

As to the nature of the leaks they may be classified as follows:

		per cent
Service leaks	84	39.0
Blown or leaking joints in mains	66	30.0
Abandoned services	28	13.0
Broken mains	15	6.9
Valves and hydrants leaking underground	13	6.0
River crossings	5	2.3
Open blow offs	3	1.4
Sand Holes (so called)	3	1.4
	217	100.0

The value and urgency of waste detection work are largely subject to conditions of supply. During the threatened water shortage of 1911, waste detection work was considered of great value irrespective of the service, i.e., whether pumped or gravity. Later, with the danger of water shortage eliminated and the ample Catskill supply near at hand, the value of waste detection work in the low or gravity service was considered of lesser value and underground waste detection work

was confined principally to the pumped services where the cost of pumping and the capacity of the stations were involved. During 1911 the special plumbing inspection and repairs resulted in a saving of about 12 per cent of the total consumption within a very few months as determined by pitometer gaugings of the total consumption made before and after the inspection in 17 districts covering the greater portion of Manhattan Island. On the other hand with underground leaks it is impossible to secure any great saving without extensive investigations, requiring considerable time. A saving, however, due to repairing of underground leaks may be considered of far greater permanence. It has been found that the leakage stopped by special plumbing inspection and repair will again develop in from two to four years, while it may readily be assumed that underground repairs to service pipes, blown joints, abandoned services, broken mains, etc., would leave the system as good or better at those points than the original construction and that the saving of water secured is practically permanent. It has also been found that in Manhattan and Bronx a large proportion of the leaks find a channel through the loose rock and soil to sewers or other outlets and may continue indefinitely without being found.

During 1913, 56 underground leaks were located and repaired, totalling 5,390,000 g.p.d. None of these leaks was apparent from surface indications, and assuming that on the average they would have continued for two years only, before being found and repaired through complaints, damages, etc., the total cost of the work was $3.55 per million gallons. During 1914, 64 leaks were located and repaired, totalling 11,000,000 g.p.d. of which one-half or 5,500,000 g.p.d. was included in two large leaks. Estimating the cost by the same method as above considering only the 5,500,000 gallons, comprising 62 of the 64 leaks, the cost would be $3.24 per million gallons. On the assumption that these leaks would otherwise have continued for 10 years the cost would of course be reduced in inverse proportion to about 70 cents per million gallons.

This underground waste detection work is entirely aside from the regular repair work as carried on by the repair gangs, which work is concerned principally with leaks which have already made themselves manifest or are causing complaints. The force mentioned by Mr. Brush employed in the search for leaks which are not apparent from surface indications or from complaints received is

employed very largely on determination of hydraulic gradients and pressure studies in connection with new mains and reinforcement of the system, measurement of flow in trunk mains measurements of con umption in large sections of the distribution system, etc. The time which this force spends at present on underground waste detection proper would be equal to about one-third time. Systematic searches for leaks are carried on in areas where consumption is found to be high and are usually taken up by means of pitometer gaugings showing ratio of minimum night rate to the total consumption followed by the usual subdivision of the district to localize waste; these results being followed up by aquaphone soundings, inspection of sewers, service pipes, etc., for final location. Leak locating is otherwise called for in emergencies where the damage is such as to require prompt location of the break and also investigations are started due to indications obtained in connection with other work. In nearly all cases it has been found that by the methods employed with a generous admixture of study and detective work by the engineer in charge leaks can be uncovered and repaired on an average with but one or two street openings. Thus in 1914 the 64 leaks previously mentioned required 80 street openings, an average of $1\frac{1}{4}$ openings for each leak. During the severe weather conditions in January and February of that year one gang of laborers was given aquaphones and allowed to cover an area in which it was desirable to reduce leakage. The competition between the men resulted in a considerable list of "noisy" hydrants, gate valves, etc., which were individually followed up in more favorable weather with a careful investigation by the assistant engineer in charge of the gang, with a view of uncovering the leaks with the least possible number of street openings, and as a result 22 leaks totalling 1,400,000 g.p.d. were located and repaired with but 27 street openings. In general, considering the cost of the work, it is not thought to be profitable in New York City to search for leaks smaller than from 25,000 to 30,000 g.p.d. unless there is some definite indication of their location, or damages are being caused thereby. The latter reason has often called for long drawn out and discouraging work, but in general with gratifying final results; as an instance, it recently became necessary to locate a leak amounting to only 100 to 200 g.p.d. By house to house aquaphone tests of plumbing the leak was found in the basement of a dwelling on an

adjacent street, one street opening having been made in the course of the search, to disconnect and make a positive test of the service pipe of the house which the water was entering.

On various occasions special methods have been used where conditions have suggested them. The ratio of pressure loss between two points when supplying the leak between them from alternate directions may sometimes be used. In one instance the leak from a small main on a down grade was located by means of a shut-out with a sensitive gauge connected at the foot of the hill, the pressure dropping steadily until the gradient or water level at the leak was reached. The pressure then remaining constant indicated the elevation of the point of leakage on the main above the gauge elevation, and the leak was uncovered with one street opening at the point determined. Hydraulic gradients may be used to advantage when the leakage is large in comparison to the capacity of the main.

A combination of gradient and aquaphone methods was recently used in locating a break in about 3000 to 4000 feet of 12-inch sub-marine main. Valves were so closed as to supply the leak from one direction through a long line of 12-inch on the main land. Levels were run and the distance measured between two hydrants on this line, and simultaneous pressures taken on the hydrants with accurate gauges. The slope of the hydraulic gradient in feet per thousand feet was thus obtained. Levels and simultaneous pressures were then taken on hydrants at either end of the broken submerged main. Assuming of course that the gradient would be level from the dead end back to the point of the break, the difference in gradient elevation at the two hydrants divided by the gradient slope determined on the main land gave the approximate distance of the break from the hydrant on the supply end. This approximate location was followed up by aquaphone tests, made from the bow of a launch. The launch cruising as nearly as possible along the location of the main was stopped at various points where the aquaphone was used on an oar with the blade immersed in the water. The leak sound was distinctly picked up and the location of greatest intensity of sound selected and fixed by means of stadia rod on the boat and a transit on land to be about 600 feet out. The diver in repairing the leak was instructed accordingly, and found the break within about 100 feet of the distance calculated.

DISCUSSION

THE YONKERS WATER SUPPLY AND ITS FUTURE DEVELOPMENT[1]

MR. EDWARD WEGMAN: Mr. Fulton has pointed out the difficulties which Yonkers encounters in trying to increase its water supply. The sources which would be suitable for this purpose have been acquired by the City of New York, and Yonkers is, therefore, obliged either to buy the additional quantity of water it requires from New York at a high price, or to go to a considerable distance for a new supply. Under these circumstances there was nothing left for Yonkers to do but to develop its present sources of water supply to their utmost limit, and to trust that, in the course of time, a Metropolitan Water Board, similar to the one of Boston, Mass., will be created to take charge of the water supply of New York and of the near-by towns and cities.

The manner in which Yonkers intends to increase its present supply has been described fully by Mr. Fulton, and leaves little room for discussion. The only feature of the proposed work which involves difficult construction is the proposed earthen dam, which is to raise the high water level of the Grassy Sprain Reservoir forty feet. This dam is to be built about 350 feet down-stream from the present dike, and will have a length of about 1070 feet, and a width on top of 24 feet.

The dam will have a height of about 90 feet above the surface, which will place it among the high earthen dams of America. Most engineers will agree that it is more difficult to construct a high dam of earth than of masonry. With the latter material, a leak through the dam causes usually only a loss of water; while with the former material, a leak may lead to the failure of the dam. In order to prevent undermining, an earthen dam should be provided with a masonry or puddle core-wall, which should be carried down to an impervious stratum.

At the site selected for the Yonkers dam, rock lies at a distance of about 90 feet below the brook, and as the rock valley is wide, there is a large quantity of material overlying the rock. This

[1] A paper by Mr. D. F. Fulton, read at the meeting of the New York Section of the American Water Works Association, December 3, 1914, and printed in Vol. 2, No. 1, of the JOURNAL of the Association at p. 1, etc.

material is sand of varying degrees of coarseness, and much of it is so coarse that water flows freely through it.

It would be very expensive to dig a foundation trench to rock for a core-wall through such material. Mr. Fulton states that it has been suggested to obtain a cut-off for the dam "either by driving steel sheet piling to rock, or, in the deeper part of the valley, by sinking a connected series of caissons and filling them with grout or concrete." If the material overlying the rock were uniform, that might possibly be done. But the speaker is told that this material is a glacial drift, containing more or less boulders. It is very doubtful whether steel sheet piles could be driven 90 feet deep through such material, so as to make a practically water-tight cut-off. If caissons were sunk, this work would not only be very expensive, but would involve much difficulty in getting the caissons down vertically to rock, so as to make a tight cut-off. Quicksand or a sliding of the sand, would deflect a caisson from the desired position. At the Hauser Lake Dam, caissons for a coffer-dam were sunk to a depth of 70 feet, but that was through water. It would evidently be more difficult to sink a caisson through sand, quicksand and boulders to a depth of 90 feet.

In drawing attention to the difficulties that will doubtless be encountered in constructing the proposed dam across the Grassy Sprain, at the site selected, the speaker does not wish to imply that this work is impossible, but it will be very expensive and if it is not done properly, may lead to the failure of the dam. The present Grassy Sprain Reservoir has been formed by an earthen dam constructed on similar ground as that at the site of the proposed dam; but it stores only about 50 feet of water, and when the depth of water at the dam is raised to nearly 90 feet, undermining of the dam may occur, which would not take place with the lower head.

Many failures of earthen dams have occurred, even when these works were built by good engineers. The terrible disaster caused by the rupture of the Johnstown Dam in Pennsylvania is the worst case of this kind that has occurred in America. This dam was 70 feet high. It was ruptured by water flowing over its top, after an unusually heavy rainfall. In England one of the most notable failures of an earthen dam is that of the Dale Dyke Dam, which was constructed for the Sheffield Water Works. This structure was 95 feet high by 1254 feet long. It was 12 feet wide on top and about 500 feet wide at the bottom. Both slopes were made $2\frac{1}{2}$ to 1. In

the investigations that took place, after the rupture of the dam, the greatest engineers of England testified as experts, but their opinions as regards what started the failure, varied very much, and this question was never finally settled.

DISCUSSION

A SPECIAL WATER STANDARD[1]

MR. JOSEPH RACE: The chief interest to the speaker in this paper lies in the standards adopted for the maximum limits of impurity to be permitted in water supplied by common carriers engaged in interstate commerce. This standard is divided into two clauses, first—bacteria capable of development on agar at blood heat and secondly—a B. Coli limit. Whilst the latter will probably meet with general approval undoubtedly the former will be the object of severe criticism both on account of the general method and the numerical limit. It is very much to be regretted that the Commission has repeated the mistake of the Water Committee of the American Public Health Association in adopting the agar count at 37°C. as many bacteriologists are now convinced of its general weakness. Without going into the "pros" and "cons" it is sufficient to say that the bacteria counted by this method in many cases are derived from sources that have no connection with matter that may be infective. Whilst the speaker has not had occasion to examine many samples of the water supplies of carriers the general experience with waters of this class has been that the bacterial count on agar is too largely influenced by bacterial multiplication during transportation to have any real value. A low count is of course generally indicative of satisfactory conditions, but a high count, on the other hand, should not "per se" condemn the sample. Those who have had experience in the examination of such waters can usually distinguish between plates showing a large count due to original contamination and excessive counts due to bacterial development but it is practically impossible to express this difference numerically or to standardize it.

The only advantage of this standard, in the opinion of the speaker, is that it practically compels the provision of *fresh* water although this is evidently not the intention of the Commission for they state

[1] A paper by Mr. Wilson F. Monfort published in the JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION, Vol. 2, No. 1, at pp. 65, etc.

that very liberal limits were allowed so as to discount multiplication of the bacteria.

As a rapid method for the enumeration of organisms of faecal origin I have for some years employed neutral red bile salt agar (rebipelagar) in 150 mm. plates with 10 cc. of sample. Such plates are examined after 20 to 24 hours incubation and the number and size of the red colonies noted. Small colonies are due to attenuated organisms and such colonies may be found on the plate although the lactose bile tubes remain negative.

The results obtained by this method vary in the same direction as the confirmatory lactose bile tube method adopted by the Commission, but, as they also include some attenuated organisms, the numerical results are higher.

The differentiation of attenuated and virile organisms is an advantage rather than otherwise as it affords valuable evidence of the past history of the supply in addition to its present condition.

The speaker also likes to see Rebipelagar used as an alternative to litmus lactose agar and Endo's medium in the confirmation of B. Coli on account of the facility of preparation and technique. In laboratories where large numbers of water samples are examined daily it is of considerable advantage to facilitate media preparation and examination technique as far as possible when consistent with accuracy.

The general principles involved in the confirmatory methods for B. Coli as suggested by the Commission, are excellent and should be adopted for all water supplies.

DISCUSSION

THE ACQUISITION OF PRIVATE WATER PLANTS BY MUNICIPALITIES[1]

MR. EDWARD WEGMAN: Mr. Wagner has made a careful study of the subject of valuations of the plants of private water companies. While he has no new theories to advance, he reviews in his paper the whole subject of valuations. The tables, giving important court decisions about water works valuations, and the bibliography appended to the paper will be very useful to engineers and water works superintendents, who are called upon to make estimates of the value of the plants of private water companies.

[1] A paper by Mr. B. M. Wagner, printed in Vol. 2, No. 1, JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION at pp. 25, etc.

DISCUSSION

DRY FEED OF CHEMICALS IN WATER PURIFICATION[1]

MR. WILSON F. MONFORT: The organism referred to in this paper (page 204–5) is one on the border line between algae and bacteria. It is the *Chlamydothrix ochraces* of Migula, called *Leptothrix* by Kutzing and *Streptothrix* by Cohn. Among the synonyms mentioned by Wolle are Lyngbya (Thur.), Conferva (Dill.), Oscillatoria (Crev.). The branched form is represented by Dillwyn, and Wolle figures it thus in one plate, with the remark "so are most of our specimens." Chester (Man. of Det. Bacteriology) prefers *Cladothrix ochracea*, following Winogradsky.

The organism is easily grown in a 5 to 10 per cent solution of ferrous sulphate; within a few days the growth on a submerged slide shows characteristic development with false branching. It stains with aniline gentian violet, which renders easy observation of false branching, conidia, and the formation of the gelatinous sheath on older specimens.

As observed first the iron tank in which it occurred was tufted over with a growth up to three inches long, which was broken off by the dash of the inflowing solution.

Some experiments to ascertain the source of the infection indicate that the organism develops in sterile distilled water in which is dissolved ferrous sulphate as it arrives in cars lined with building paper. Whether it was originally derived from water used in preparing the sulphate of iron, or from the building paper was not determined.

The most remarkable fact about this species is its ability to grow in a solution of ferrous sulphate, and in any concentration up to saturation. The stoppage of pipes by this growth has been observed in several purification plants. The remedy lies in reducing to a minimum the length of pipes conveying such a solution, and the avoidance of orifices for regulating the volume of solution applied. Dry feeding offers the best way out of the difficulty.

MR. J. W. ELLMS: We have found organisms of the type of which Mr. Monfort speaks at the Cincinnati Filter Plant. Although we

[1] A paper by Mr. Wilson F. Monfort published in Vol. 2, No. 1, of the JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION, at pp. 200, etc.

have been unable to find the branched forms, the organisms that we did observe certainly belonged to the class which include Leptothrix and Crenothrix.

The organisms observed by us were found in the sulphate of iron solution tanks in the sludge attached to the sides of the tank. This sludge or deposit is of the same character as that found in our iron sulphate solution pipe lines. We have always had more or less trouble from the partial stoppage of these pipe lines by this deposit. Until Mr. Monfort called attention to these organisms, which will grow in a sulphate of iron solution, the speaker had always attributed the difficulty primarily to the ferric hydroxide produced by the oxidation of the ferrous iron by the oxygen dissolved in the water used in preparing the solution. Our chemical solution pipe lines are very long, and contain a good many elbows. The first pipe lines used were of cast iron and $3\frac{1}{2}$ inches in diameter. On account of the low head available for forcing the solution through these lines, even slight obstructions would cut down materially the rate of flow. A new pipe line 5 inches in diameter was installed, but the trouble still continues, although the stoppages are less frequent.

Mr. Monfort's discovery offers a possible explanation of these stoppages which would never have occurred to the speaker. We have found that stoppages were more frequent during the winter months or when the water was at a low temperature. During the hot months, little trouble has been experienced. We have found that flushing these pipe lines under pressure with cold water is often ineffective. Driving steam and hot water through the pipes seem to clear them more effectively than does cold water.

Our laboratory observations of the growth and appearance of these organisms confirm those of Mr. Monfort, excepting those relating to the branched forms. All filter plant operators using sulphate of iron solutions would do well to investigate their pipe lines and tanks in order to learn whether like conditions prevail in their own plants.

DISCUSSION

EXAMINATION OF DRINKING WATER ON RAILWAY TRAINS

MR. FREDERICK H. STOVER: Will Dr. Bartow please state if these new standards apply to steamers on inland lakes and rivers, and whether they would apply to excursion steamers between local points? Many of these steamers take their supply from the nearest sources, very often from the stream on which they run. Can anything be done to standardize the water supply on them?

DR. EDWARD BARTOW: Any interstate carrier, whether by rail or by water, would be controlled by these standards, they are being used for steamers on the Great Lakes, and probably on river steamers too.

MR. FREDERICK H. STOVER: From one part of a state to another?

DR. EDWARD BARTOW: Yes. Would not want to give that as authentic.

[1] A paper by Prof. Edward Bartow, published in the JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION, Vol. 2, No. 1, at pp. 74, etc.

STUDIES OF ARTESIAN WATERS IN CHICAGO AND SURROUNDING TERRITORY

By Carl B. Anderson and F. W. DeWolf

INTRODUCTION

The rapid decrease in the artesian water supply of Chicago and the surrounding region was brought to the attention of the State Geological Survey in 1912, and arrangements were made to coöperate with the State Water Survey in a careful investigation. The field and laboratory work is now finished and a preliminary statement of some of the striking features is presented to the Illinois section. The following items relating to the Chicago area are considered briefly: underground water supply; water-bearing formations; artesian conditions; lowering of water table, and chemical quality of waters. Plate I illustrates the area concerned, and shows the variation in water table by means of 10-foot contours.

UNDERGROUND WATER SUPPLY

Northeastern Illinois has an underground water supply of great value to cities and small towns, and to industrial demands, in view of the fact that the streams are small and their waters are of poor quality.

Underground water is obtained from three kinds of wells: shallow wells in the surface formations, shallow rock wells, and deep rock wells which are artesian in character.

The first two groups are large producers of water only in isolated cases where the sand and gravel are very thick, and the rock is shallow and very porous. The deep wells, however, are generally available as a source of water. Many large industries in Chicago, which require large amounts of water at a low cost, have drawn heavily on these underground water resources.

WATER-BEARING FORMATIONS

Surface deposits. The surface water-bearing beds include unconsolidated sand, clay and gravel deposited directly or indirectly by the glaciers, and also the sand deposited in a larger lake, which preceded Lake Michigan. The constituent materials vary greatly both in size and character. The thickness around Chicago ranges from a very thin coating to over 100 feet.

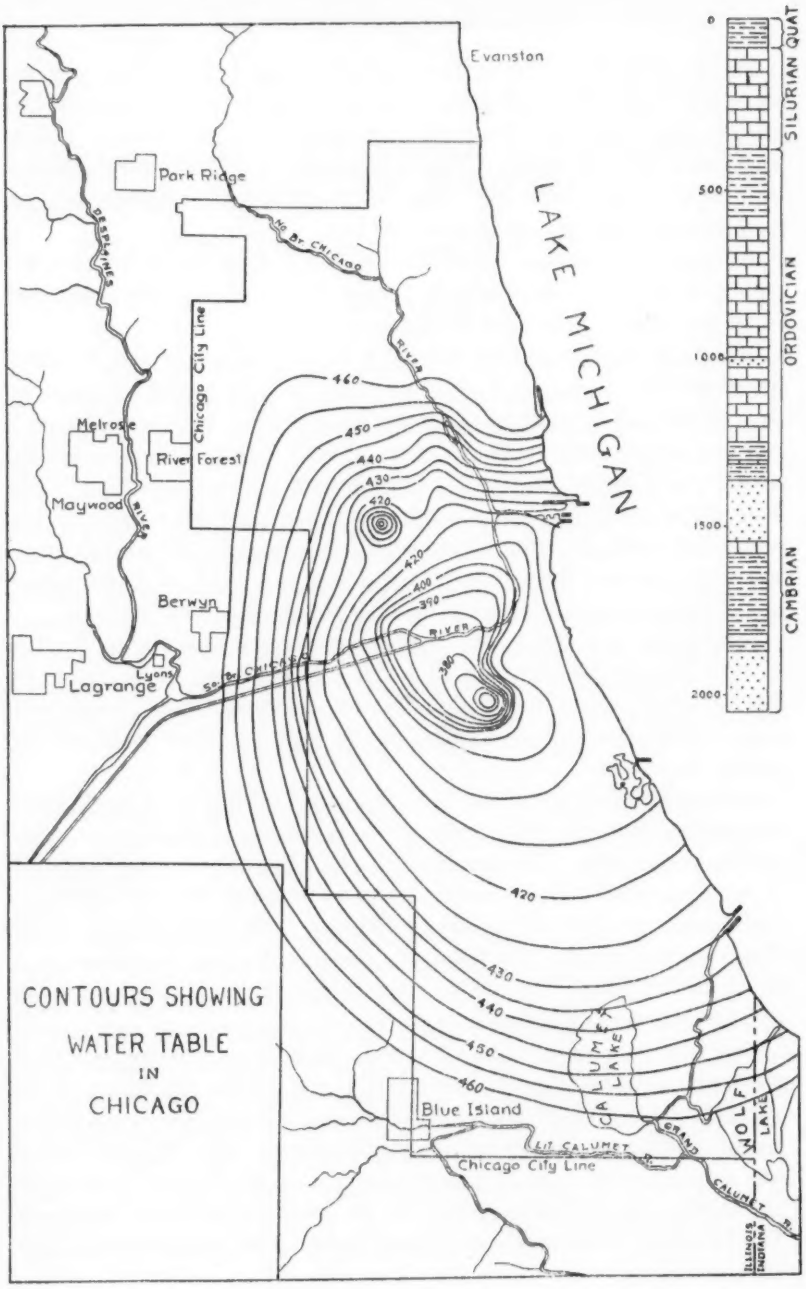
Wherever the surface materials are as thick as 100 or more feet, plenty of water can generally be obtained for domestic purposes, for small factories, or even for municipalities.

The only hard rock that outcrops at the surface is the Niagara limestone or "bed rock," which can be seen in many quarries in the vicinity of Chicago. The thickness varies between 150 and 300 feet, averaging about 250 feet. Locally, the Niagara contains considerable water, due to the presence of fissures and to a thick layer of porous drift which receives the rainfall. Such a belt extends north and south through Hinsdale, Illinois, and finally swings eastward and passes through Chicago Heights. Both of these cities obtain large amounts of good water from shallow rock wells.

Deep water supplies. The deeper formations underlying Northeastern Illinois are shown in Plate II. The Niagara is from 200 to 300 feet in thickness and is underlain by the fine-grained Maquoketa shale which is practically impervious to water. Other beds call for special mention:

Galena-Trenton limestone. The Galena-Trenton is a light gray, fine-grained dolomite or limestone which contains considerable magnesium carbonate. Fragments of chert nodules and a small amount of rounded quartz grains have also been found in the well drillings. The thickness varies from 300 to 450 feet. The first flow of water obtained in Chicago was from the Galena-Trenton limestone at a depth of 711 feet. The water rose to 80 feet above the surface or 111 feet above Lake Michigan.

St. Peter sandstone. The St. Peter sandstone formerly furnished great amounts of artesian water in Chicago. The thickness varies abruptly from 20 feet to over 250 feet, and the well driller may even report finding no sandstone at this horizon. The St. Peter sand was deposited on a very uneven surface of the Lower Magnesian limestone, which thus accounts for its great variation in thickness. The St. Peter is composed of a remarkably pure, well-rounded, siliceous sand.


Evanston
Park Ridge
Melrose
River Forest
Maywood
Berwyn
Lyons
Lagrange
Chicago City Line
LAKE MICHIGAN
460
450
440
430
420
410
400
390
380
CONTOURS SHOWING
WATER TABLE
IN
CHICAGO
Blue Island
Chicago City Line
WOLF LAKE
0
500
1000
1500
2000
SILURIAN
QUAT
ORDOVICIAN
CAMBRIAN

The drilling of a large number of wells to the St. Peter sandstone resulted in an extremely heavy drain on these underground water resources. There were still flowing wells from this bed in Chicago during the early '90's, but at present it is impossible to obtain sufficient quantity of water from this formation for industrial purposes.

Lower Magnesian limestone. The Lower Magnesian lies next below the St. Peter sandstone. It is considerably fractured at a certain horizon about 1200 feet below the surface, and contains water in these fissures. The deep well at the Western Electric Company's plant, during the summer of 1912 was tested at this horizon, and yielded slightly over 200 gallons per minute without the water level being lowered over 10 feet.

Potsdam sandstone. The Potsdam sandstone generally means the first, heavy, sandstone member of the Potsdam series, sometimes called the Madison sandstone. It is found in Chicago at a depth of 1350 to 1400 feet. The first 100 feet is usually light brown, and is followed by 100 feet of a cream-colored sandstone. Below the Madison there is a somewhat sandy and shaly dolomitic limestone for another 200 feet. Underlying this limestone, other heavy beds of light brown, red, buff, or white sandstone, alternate with thin beds of dolomite and shale. The sand as a rule is coarser and not as well rounded as that of the St. Peter formation.

The Potsdam rocks are the oldest penetrated in the Chicago region and are known to a depth of at least 1000 feet.

The chief interest attaches to the Potsdam because it yields by far the greatest amount of artesian water used in the Chicago area. The main water-bearing stratum is the Madison, which wherever penetrated by a well of sufficient size, yields 300 and more gallons of water per minute.

ARTESIAN CONDITIONS

The term "artesian well" is applied to one whose original source of water is at a considerable distance, whether the well flows or not. This water has collected from rainfall in an area rather remote from the well, and has traveled under hydrostatic pressure through a porous bed until tapped at a point lower than the source.

The porous formations in this region are: the sandstones of the Potsdam series, the St. Peter sandstone, and to some extent the Lower Magnesian limestone. The Potsdam and the St. Peter are

the main water-bearing strata. They rise to the north and outcrop in south-central Wisconsin, at an altitude higher than that at Chicago.

The relatively impervious beds lying above the water-bearing formations prevent the escape of the waters until tapped by drilling. The overlying beds need not be entirely impervious provided they are filled with water, so that the downward pressure of the water is as great as the upward pressure of the water contained in the lower formations.

LOWERING OF WATER TABLE OF DEEP WELLS

Historical. The first artesian well was drilled in Chicago in 1864 at the corner of Chicago and Western avenues, and yielded a strong flow of water from the Galena-Trenton limestone at a depth of 711 feet. The water rose to 80 feet above the surface or 111 feet above Lake Michigan.

There were still flowing wells from the St. Peter in Chicago during the early '90's.

Since that time, with the increase in the number of wells drilled, there has been a gradual loss of hydrostatic pressure, even though the wells have been drilled deeper. At present all wells that furnish large quantities of water penetrate the Potsdam series. The water level has been lowered from 80 feet above the surface, so that now it is 220 feet below the surface when at rest, or 235 feet when pumping, in the stock yards district, where a large number of wells operate in a small area.

The greatest decline has been in the past 5 years during which time more large wells have been drilled than during any previous 5-year period.

A map with 10-foot contour interval has been prepared for the city of Chicago, showing the artesian water table as it was in October, 1914. The figures on contours indicate elevations above sea level. The hydrostatic pressure rises rapidly after leaving the stock yards, and then more gradually towards the outer parts of the city.

Effects of pumping. During the summer of 1914, when the greatest amount of water was being pumped in the stock yards district, the water level would fall to 232 feet below the surface. This would affect the area within a radius of one-half mile, even though certain wells would be idle. The lowest water level of 235 feet was measured in a large well pumping over 1500 gallons per minute. Meas-

urements obtained on many wells in this district showed that immediately after cessation of pumping there would be a gradual rise of about a foot in the first hour, and beyond that time no noticeable rise, even though the well was shut down for a number of hours. This was the case when the other wells in the stock yards were pumping to capacity. Measurements made, however, on a Sunday afternoon when only about half as much water was being pumped as on week days, showed a water level of 212 feet below surface, and indicated a rise of 20 feet.

Another example of the effect of pumping so large an amount of water was shown in a new well located about one-half mile from the group of largest wells. This well showed little water until the St. Peter sandstone was penetrated at about 900 feet, when the water rose to the general water level of the stock yards district. The St. Peter formation over other parts of Chicago no longer furnishes much water. The water from this new well was analyzed and found to be of the same character as that obtained from the deeper sands by other wells in this district. Thus it appears that the water from the Potsdam formations rises and enters the St. Peter sandstone, because of lack of casing in neighboring wells.

MINERAL CONTENT OF WATERS

The water obtained from the large producing wells in Chicago is a very hard, sulphate water, with mineral matter varying from 60 to over 100 grains per gallon. Wells deeper than 1800 feet encounter salt water, thus increasing the total mineral content to a very high amount. The water is primarily used for condensing and cleaning purposes.

Detailed analyses made by the State Water Survey of water from typical wells were presented in a paper last year by Mr. Anderson.

THE APPLICATION OF THE THEORIES OF PUBLIC REGULATION TO THE MANAGEMENT OF UTILITIES

By Douglas A. Graham

Regulation or control of public utilities must do justice to both the public and the utility or it cannot endure. Much has been said and written concerning the rights and interests of the people, and, in some cases at least, statements have been made with so small an understanding of the object of just utility regulation as to make it appear that the rights of the people are in jeopardy and that the authors of these statements are advocates in the case of "The People versus the Corporations."

This condition of affairs is not and should not be the case. The contention of the utilities in demanding fair returns is based on the provisions of our national constitution which refer to property rights, and, while the people have the right to demand efficient service in return for the privileges granted by them, they must be prepared to pay for what they receive. In other words the interests of both parties can best be served by devising fair and simple means of providing a fair return to the utilities in return for adequate service furnished to the public.

Millions of dollars are invested in public utility properties, and, when such money is devoted to the public use, the public must feel its responsibility toward such capital and must treat it with wisdom and justice.

FUNDAMENTAL PRINCIPLES

The fundamental requirements of just regulation may be stated under three headings.

1. To provide a fair return on the investment at all times.
2. To protect the capital invested so that it may remain intact or ultimately be returned to the investor.
3. To promote efficient management and to require adequate and satisfactory service.

Much has been written about the theories of regulation and there is little real difference in opinion among men who have knowledge of these matters. Less has been said and done to devise means for putting these accepted theories into practice and still less attention has been given to helping the utility operator to understand and apply these principles to his own particular property.

The movement toward public regulation by commission has spread rapidly of late years and, in general, it has been welcomed by both the utilities and the people. Unfortunately the subject of just and practical regulation is a difficult and complicated one and the rapid growth of the movement toward state control has created a demand for more men skilled in these matters than the profession has been able to supply. It may almost be said that the movement toward public regulation has grown more rapidly than the knowledge on the subject itself, and the result has been that commissioners have been forced, in many cases, to solve their problems as they have arisen, often without the aid of those especially trained in the work. Unfortunately this lack of preparedness and the newness of the field has sometimes led to an exaggeration of the value of precedent, and many opinions, methods and rules, inspired in the past by the necessity of arriving at some conclusion, have been perpetuated, simply because "precedent" furnished the necessary semblance of authority.

Nothing is further from the mind of the writer than that he should presume to criticise or question the ability or fairness of any of the men who are entrusted with the solution of the important problems of utility regulation. The errors that have been made, if they may be termed as such, are not errors of intent or lack of skill. They are due to the magnitude and newness of the problem, to the lack of special training in many of the men engaged in the work, and to the fact that few of the men so engaged have learned by experience the viewpoint of the utility.

It has been well said that no engineer, however skillful, is competent to appraise a utility plant until he has been employed by both a utility and by a city, as only in this way can he understand the viewpoint of each in such a manner as to do justice to both in his future work. Regulating bodies are employed by the people and are constantly in danger of being suspected of favoring the corporations, and it is only by a strict judicial impartiality and an earnest endeavor to understand the viewpoint of both parties that a regulating body can do justice to both the public and the owners of the utilities.

It is earnestly hoped, therefore, that the spirit of antagonism between the people and the utilities may give place to a spirit of mutual endeavor to obtain efficient service for just compensation, and that the governing bodies will give careful attention to the claims of the utilities and solve the contended problems, not on the precedent in the case, which may have been set by lesser minds than theirs, but upon a full knowledge and understanding of the facts and a fearless adherence to logic and justice.

It is not the intention of this paper to discuss or to attempt to substantiate the fundamental theories mentioned above. It is rather the application of these theories to the management of a utility that the writer has in mind, and it is hoped that some of the suggestions offered will bring out discussion and perhaps aid in the adoption of simple and fair methods which can be easily understood and applied by the utility manager. When such rules are worked out uniform systems of accounting may be adopted and the labor of supervision and regulation will be materially reduced.

CAPITAL ACCOUNTS

The first step in preparing for public regulation or, in fact, in preparing for the intelligent supervision of a property for any purpose, is to determine its value. This can rarely be done from past construction accounts owing to the appreciations and depreciations which have taken place and to the usual inaccurate or incomplete condition of these accounts. In most cases an appraisal of the property is necessary and such an appraisal should be authoritative, and, if possible, it should be concurred in by the body by which the utility is to be regulated.

After the present value of the property is determined, the old capital and depreciation accounts may be reconciled with the new value. The total value of the property may then be subdivided in accordance with the details of the appraisal and the requirements of intelligent supervision. New detailed construction accounts may then be opened and future construction charged at cost.

All materials and labor for new construction should, of course, be charged to these accounts in the future. There are some other items, however, which may properly be mentioned as their inclusion in construction accounts has been the subject of some discussion.

Discount of bonds sold for construction seems unquestionably to

be a proper charge against the construction accounts of a growing utility. There has been much discussion of this subject in connection with the valuation of an entire property, where interest during construction, going value, preliminary costs and the like are to be computed. It is not the intention of the writer to discuss this phase of the subject or to admit that there is any difference between the two cases, but in an operating utility, where money must be raised by selling bonds, the cost of selling these bonds must be paid just as surely as the cost of labor and material. If $90 worth of construction is to be undertaken and the bond discount is 10 per cent, then $100 worth of bonds must be issued and redeemed in cash at par upon the expiration of their terms. Ultimately, therefore, the utility must pay the bond discount in cash and the cash cost of the new construction must be charged to the assets of the company as $100.

Overhead costs are often neglected in charging construction to the books because of the difficulty of determining their amount. The overheads on a small extension may be insignificant, but, when a number of extensions have been made, the total of the overhead costs may amount to a considerable sum.

During the construction season the manager or superintendent devotes part of his time to the construction work, and a charge to construction should be made for such time. Automobiles may be used partly for construction purposes and, therefore, a part of their operating costs and depreciation should go to capital accounts. There is interest lost before new construction is completed and its fixed charges can be carried in operating accounts, and there are costs for business investigations and negotiations, in connection with new construction, which are not properly a part of the operating charges. Engineering, of course, must go in with the cost of the structure for which it is procured, but, as this is usually a separate account, it is easily charged directly, and is, therefore, not a part of the indefinite overhead costs to which this article directly refers.

Such costs, and others not specifically mentioned, are a real part of construction costs and should be charged as such. The amount of these charges is, however, a difficult matter to determine in the average plant. It is possible to so divide the charges and the time of all employees as to obtain an accurate distribution of all overhead costs, but such a system would involve so much labor, and such skilled accountants, that it is beyond the reach of the average sized

utility. Perhaps the best solution of the difficulty, and one which may be made fair to all concerned, is to determine an average percentage to be charged to all construction work and to be based on the cost of the material and labor items that can be easily determined.

The amount of this percentage may vary with the size of the plant, and it will be materially affected by the number of indefinite items which it is possible to charge directly to the construction accounts. In plants in cities of 20,000 to 30,000 a 10 per cent charge will probably be reasonable, although such a percentage must not be adopted without a thorough knowledge of the items which it is intended to cover. Also, all items should be charged direct as far as it is practicable to do so and the amount of the percentage for overheads thereby reduced to a minimum.

Operating capital is sometimes lost sight of in fixing rates, though it is as much a part of the capital devoted to the public as is the money invested in machinery. Operating capital may be defined as "that capital which is not invested in permanent structures or apparatus, but which is necessary for the operation of the business and which cannot be withdrawn or used for other purposes." It includes cash in the bank or in any other form in which it may be used upon demand, and also the capital temporarily invested in tools, supplies and the like. Such money is devoted to the business and it can receive no return unless it is included in the value upon which a fair return is to be computed. It should, however, be kept separate from the fixed or construction capital as it is variable and its depreciation should be treated separately.

Operating capital must not be confused with capital invested in non-operating property, such as lands bought in advance of their actual need. The writer believes that, in valuing a plant, no distinction should be made between operating and non-operating property, unless it can be clearly shown that the investment in property, not actually "used and useful" for the service of the public, was not made in the sole interest of the utility plant.

If property is non-operative because of obsolescence or poor condition, its value should be reduced or perhaps totally removed by means of the depreciation placed upon it, care being taken to consider all of the uses, both present and future, to which that particular property might be adapted. If the property is a piece of land, bought in anticipation of the needs of the plant, it should be considered that the management acted in good faith, unless the re-

verse can be clearly proven. To exclude such land because it is not now actually in use, is to discourage the utility from anticipating and providing for the future needs of the plant.

The object of keeping detailed construction accounts is to be able to consider intelligently costs of construction and operation. The division of these accounts should, therefore, conform to the units of a property for which cost data are commonly available. For example, the important general divisions of a water works plant are the water supply, the purification plant, the pumping station, the distribution system and one or more divisions for general costs, applying to the entire plant, such as overhead costs and going value. Land should be subdivided and charged with the division to which each part belongs. Other general subdivisions may be made, if necessary, to suit the requirements of each particular plant. The available costs of filtration are mostly in the form of construction costs per million gallons daily plant capacity, and operating costs per million gallons filtered, and one must know the value of the filter plant as a unit in order to compare its value with that of other plants, or to figure the element of fixed charges in finding the total unit cost of purification.

The subdivision of the main construction account headings will vary considerably in several plants and must be suited to the needs of each. In general it may be said that the classification should be based on the estimated lives of the various parts of the plant. While it is not intended to prescribe a definite form for the classification of construction accounts, the following arrangement is offered merely as an illustration of the principles discussed above:

CLASSIFICATION OF CONSTRUCTION ACCOUNTS

Intangible capital
- Organization and preliminary costs
- Going value

Water supply capital
- Lands
- Well houses and equipment
- Miscellaneous equipment

Purification capital
- Lands
- Buildings
- Filters
- Pumps
- Blower and motors

Purification capital—Continued
- Miscellaneous equipment
- Upper storage basin
- Lower storage basin

Pumping station capital
- Lands
- Main buildings and stack
- Miscellaneous outbuildings
- Boilers and breeching
- Feed pumps and boiler accessories
- Pumping machinery
- Electrical machinery
- Miscellaneous equipment
- Ground improvements and switch track

Distribution system capital
- Cast iron pipe mains and valves
- Hydrants
- Pavement over C. I. pipe mains
- Wrought iron pipe mains and valves
- Pavement over W. I. pipe mains
- Service connections
- Meters

Overhead construction capital
- Interest, administration, superintendence and miscellaneous costs @ 10 per cent of material and labor cost
- Legal expense.
- Injuries and damages
- Insurance
- Discount or commission on construction bonds

Operating capital
- Cash on hand
- Stores and supplies
- Tools and appliances

A very convenient summarized construction account book for a small plant, may be made from an ordinary column-ruled book which can be purchased at a stationery store. The general headings and subdivisions may be written at the top of each page and the accounts opened with the details from the appraisal, a column at the right being used for totals. The item may be described at the left and the total cost entered in the proper column. Such a book would give an up to date classified record of the value of the plant and would be very valuable in making annual reports.

DEPRECIATION

The treatment of depreciation and the computation of the amounts of the annual charges for this item, are among the most difficult of the problems with which the utility manager is confronted. In the competitive commercial world the depreciation account is purely a matter of business policy, but where a utility is under public control, and the obligations of the public and the corporation are mutual, depreciation is no longer a matter of policy but becomes subject to the laws which govern the fixing of a fair return.

The presumption in fixing rates is that the utility shall earn a fair return on the value of its property, and in addition an amount annually which will be sufficient to make good the depreciation losses. It is generally conceded that an allowance should be made for depreciation in the revenues, but the manner of computing this allowance and of treating it in the book accounts is still the subject of much discussion and difference of opinion.

The allowance for annual depreciation must cover future losses only, as the courts have held that a utility cannot make charges in the future to compensate for losses in the past. It is this principle which makes it essential that the depreciation allowance be actually received before it is deducted from the capital, for an allowance on paper only is misleading and is of no practical benefit to the utility. The question of the actual receipt of the depreciation allowance will be considered more fully under the heading of Fair Return, and the following discussion will assume that the depreciation allowance is to be actually received.

The first and perhaps the most important question to be decided, in determining the manner in which the depreciation allowance shall be treated, is whether it shall become a part of a replacement fund, out of which replacements or renewals will be made, or whether it shall be considered as a partial repayment, by the public to the utility owners, of the capital devoted to the public use. The principles involved are the same in each case as by either plan the investment is maintained intact. The former plan is familiar to the general public but it has many drawbacks. The latter plan, which appears to have many advantages, was suggested by a special committee of the American Society of Civil Engineers in their recent report on "Valuation for Rate Making Purposes."

The replacement fund method involves the estimation of the

depreciation of all of the details of a plant and an accurate distinction between that part of a new structure which is a replacement and that which is an improvement. An old machine is never replaced by a new one of exactly the same size and kind. There is always some improvement. A replacement fund is made up of annual increments which will replace each part of the plant as its life comes to an end. When a new machine is installed it is necessary, therefore, to take part of its cost from the replacement fund and part must be paid with new capital. If the life of the old machine has been accurately estimated, this is not a very difficult proceeding, but if this life has not been exactly predicted, the provision for amortizing the value of the old machine is either insufficient or more than enough and it is a difficult matter to determine just what part of the new cost shall be taken from the replacement fund. In short the accurate maintenance of a replacement fund requires a system of accounting beyond the reach of most utility companies, and, unless such a system is faithfully carried out, the replacement fund loses much of its merit and becomes largely a matter of guess work.

In the repayment method, as its name suggests, the depreciation allowance is considered as a repayment of the invested capital, to be deducted from the capital account and used as new capital. The merit of this plan is its simplicity as, when the amount is fixed by careful appraisal, it is handled as a lump sum and no tedious details are necessary. All replacements or additions are charged in full to capital accounts and the annual depreciation allowances are deducted from the plant value. The results obtained with this plan are the same as those with the replacement fund, as, in each case, if all worn-out structures were to be replaced with identical new ones, the construction account would always remain the same. The difference between the two methods is one of accounting only, but the simplicity gained by the treatment of depreciation as a lump sum repayment of capital is worth much to the utility manager.

There are three plans which have been devised for computing the amount of the annual depreciation allowance. These are the sinking fund, the straight line and the equal-annual-payment plans. All three require an estimate of the present value of the plant and its composite remaining life.

The sinking fund method is familiar to all. The annual allowance is the increment to a sinking fund which will retire the investment

at the end of its life. This method requires the creation of an actual sinking fund for replacements as its interest additions each year must come from the investment of the fund. Few companies care to carry an actual sinking fund on account of the low interest rates which can be earned by such a fund. Also there are serious accounting difficulties which arise when the working of the sinking fund principle is disturbed by the removal of money for replacement purposes and by the constant changes in the composite life of the plant, due to additions and alterations. It is believed that in practice the theoretical working of a replacement fund on the sinking fund principle can only be approximated at best, and the difficulties involved are quite enough to discourage the ordinary utility manager.

The straight line method of computing the annual depreciation allowance commends itself by its simplicity. Under this plan the total physical value of the plant is divided by the number of remaining years of the composite life of the property and the result is the annual depreciation charge. It has two serious objections, both due to the fact that its amount is the same from the beginning to the end of the plant life.

Experience shows that actual depreciation is small during the early years of the life of a plant and that it increases rapidly during the later years of operation. The sinking fund method is designed to approximate the working of this law but the straight line method produces results which are too great during the early years and too small during the later years of the life of a plant. Also the straight line allowance bears no relation to the probable income which a plant will receive. It imposes too heavy a burden during the early years of development and it is too small during the later years when the income is more fully developed. This method, therefore, while simple in operation, is absolutely arbitrary and is not well suited to the requirements of a public utility.

There is another method, also suggested by the committee of the American Society of Civil Engineers which has been referred to above. It has been called by it the equal-annual-payment plan, and takes its name from the fact that by its use, at any given interest rate and considering no additions to the plant, the total of the depreciation allowance and the fair return is the same each year during the life of the plant. If plant additions are considered, the constant amount of the depreciation plus fair return changes to a constant percentage of the total plant value.

The equal-annual-payment or E-A-P plan is, in fact, a modified sinking fund in which the interest accretions are added directly to the annual charge instead of being earned by the fund itself. This plan eliminates the complications of the sinking fund while preserving its advantages, and seems to offer a satisfactory solution of the problem.

The following table illustrates the working of the rule as applied to a given set of assumptions.

Example of working of E-A-P depreciation rule

Assumptions: Initial investment $100. Additions $5 per year. Average life of original plant 20 years; life of each addition 20 years

AGE, YEARS	FULL INVESTMENT AT END OF YEAR	DEPRECIATION DURING YEAR (5 PER CENT RATE)	NET VALUE END OF YEAR	5 PER CENT ON NET VALUE	DEPRECIATION PLUS RETURN	PER CENT OF INVESTMENT PAID BY PUBLIC IN FAIR RETURN AND DEPRECIATION ALLOWANCE
	$100.00	$3.02	$100.00	$5.00	8.02	8.02
1	105.00	3.32	101.98	5.10	8.42	8.02
2	110.00	3.64	103.66	5.18	8.82	8.02
3	115.00	3.97	105.02	5.25	9.22	8.02
4	120.00	4.32	106.05	5.30	9.62	8.02
5	125.00	4.69	106.73	5.34	10.03	8.02
6	130.00	5.07	107.04	5.35	10.42	8.02
7	135.00	5.48	106.97	5.35	10.83	8.02
8	140.00	5.90	106.49	5.32	11.22	8.02
9	145.00	6.35	105.59	5.28	11.63	8.02
10	150.00	6.82	104.24	5.21	12.03	8.02
11	155.00	7.31	102.42	5.12	12.43	8.02
12	160.00	7.82	100.11	5.01	12.83	8.02
13	165.00	8.37	97.29	4.86	13.23	8.02
14	170.00	8.94	93.92	4.70	13.64	8.02
15	175.00	9.53	89.98	4.50	14.03	8.02
16	180.00	10.16	85.45	4.27	14.43	8.02
17	185.00	10.82	80.29	4.01	14.83	8.02
18	190.00	11.51	74.47	3.72	15.23	8.02
19	195.00	12.24	67.96	3.40	15.64	8.02
20	200.00	13.00	60.72	3.04	16.04	8.02

The resulting total charge for fair return and depreciation is a constant per cent on the full investment at the end of each year.

The rule for finding the depreciation each year under this method is as follows: Find the remaining life of the plant, which would

be say 45 years, and decide on the sinking fund interest rate to be used, say 4 per cent. Find the annual increment to a 4 per cent 45 year sinking fund, which would be 0.8262 and which would be the charge for the first year. The second and succeeding years the allowance would be the charge for the previous year, plus 4 per cent of that charge, plus 0.8262 per cent of the increase in plant value during the preceding year.

The following table gives the factors for finding the first year's depreciation allowance, computed at four different sinking fund interest rates.

E-A-P depreciation factors

REMAINING COMPOSITE LIFE OF PLANT	FACTOR IN PER CENT FOR FIRST YEAR			
	4% rate	*5% rate*	*6% rate*	*7% rate*
5 years.....	18.4627	18.0975	17.7396	17.3891
10 years.....	8.3291	7.9505	7.5868	7.2377
15 years.....	4.9941	4.6342	4.2963	3.9795
20 years.....	3.3582	3.0243	2.7185	2.4393
25 years.....	2.4012	2.0953	1.8227	1.5811
30 years.....	1.7830	1.5051	1.2649	1.0586
35 years.....	1.3577	1.1072	0.8974	0.7234
40 years.....	1.0524	0.8287	0.6462	0.5009
45 years.....	0.8262	0.6262	0.4700	0.3500
50 years.....	0.6550	0.4770	0.3444	0.2460
60 years.....	0.4202	0.2828	0.1876	0.1229

The simplicity of the E-A-P plan, the nearly constant relation of its annual increment plus the fair return to the changing value of the plant, the percentage being only constant when the same interest rate is used in computing both depreciation and fair return, and the growth of its annual increment with the development of the business of the company, recommend it very highly for use in the management of a utility property.

Few utilities in this part of the country have carried depreciation accounts until the last few years and, where such accounts have been kept in the past, they have often been little more than memoranda. The amounts charged have usually been variable and not in accordance with any definite rule or principle and, as far as practical benefit to the utility is concerned, such accounts might just as well have never been created. The growing tendency toward

public control has inspired the opening of many depreciation accounts and the newness of the problem of public control, combined with lack of knowledge of plant values, has been largely responsible for the haphazard manner in which depreciation accounts have been treated in the past.

The writer believes that the most important factor in determining the proper treatment of depreciation in the operating accounts is the amount of depreciation the property is actually permitted to earn. This bears directly upon the much debated question of whether or not the depreciation allowance should be deducted from capital. Under the well accepted theory that a utility is entitled to receive a fair return and to be permitted to maintain its property value intact, it is obviously unfair to deduct depreciation from capital if such depreciation allowance is not actually earned in addition to a fair return. Also, if money is actually provided for depreciation, it must either be put back into the property by means of replacements without increasing the capital accounts, or it must be deducted from capital accounts and be considered as invested capital which has been returned or repaid by the public.

The writer makes no pretenses of being an accountant, and he is familiar only from general knowledge with the requirements of a plan of utility accounts. His experience and association with those engaged in this work, however, have taught him some of the difficulties to be avoided and the objects to be achieved. It is believed that the choice of methods for handling annual depreciation lies between the replacement fund and repayment plans described above, and, on account of the almost insurmountable difficulties in the way of the practical fulfillment of the replacement principle, it is believed that the depreciation should be treated as a repayment of the invested capital.

In planning the accounts on the repayment plan depreciation may be charged directly to profit and loss and credited to construction, or it may be carried through a separate depreciation account. The cash repayment may be charged to general cash and credited to a special cash account from which it is to be used as new capital. Other similar combinations will produce the same results. No detailed estimate of depreciation is necessary as all new and replacement capital is charged in full to construction.

In computing the annual depreciation charge, as explained above, operating capital may well be excluded. The depreciation on tools

and construction appliances should be added to the construction accounts. Depreciation on very short lived property used in the operation of the plant may properly be charged as operating expenses direct.

There are certain contingent depreciations which occur occasionally during the life of every plant. A fire may cause unexpected damage or an accident may destroy some of the machinery. A runaway may break a hydrant or a main may burst. Such unexpected depreciation is sure to occur at some time, and an allowance should be made for it in the annual charge for depreciation.

FAIR RETURN

The principles governing the operation of public utilities are pretty well understood, and it is conceded that a property is entitled to fair earnings on its investment in return for efficient service to the public. The application of these principles is quite another matter and the results obtained in the past have not been altogether satisfactory. Fairly definite estimates may be made of operating expenses, but the consumption of the various classes of consumers, the future increase in their number and the changes in plant value, are matters so indefinite as to make it extremely difficult to fix rates which will furnish exactly a fair return on the property.

In a growing city, an increase in business must be expected, and it is probable that such growth in income will exceed the increase in operating expenses, fixed charges and fair dividends. Rates cannot be revised each year and it is easily seen, therefore, that the problem of providing a fair return at all times is a difficult one.

In the past, under municipal control, regulation has too often meant a reduction of rates whenever the opportunity offered itself, and the temptation to use the issue of reduced rates as political capital has often proved too strong. The arguments for rate reductions have nearly always included estimates of future prosperity, and rates have often been fixed on the theory that future increases would make up for present losses. Unfortunately, in such cases, when the future increases have taken place administrations have changed or memories have failed and the realization of the hopes of the utility for a fair return have once more been consigned to the future.

It is often difficult for the layman to understand the hardships

and losses attending the early years of the operation of a public utility. He sees only the present and future and he is guided more by the size of his own bills and by the campaign speeches of the city politicians than by any knowledge of the task involved in the construction and development of such a business.

Under such a system of political regulation in the past the utility business has too often been a gamble with the other fellow fixing the odds. In our own and many other states this system is happily in vogue no longer, and it is to be hoped that the new era of sound regulation upon which we are entering will bring out new methods of providing a fair return which will do away with some of the hazards which have attended on such business in the past.

As explained before it is the practice of regulation, rather than the theories involved, that is still the subject of debate. It is conceded that a utility should receive a fair return, but theories and concessions will not pay bond interest, dividends and depreciation. It is the problem of how actually to obtain a fair return at all times that is of vital interest to the utility manager. The public expects efficient service at all times and transgressions on the part of the company are not easily forgotten. In fairness, then, provisions should be made that will permit the company to enjoy a fair return at all times.

A simple way to accomplish this result may be termed the trust fund method. It contemplates the creation of a trust fund to which all profits would be carried and from which the utility would be allowed to withdraw a fair return each year. Such a plan would accomplish all the results desired by both parties. If the fund should grow too fast, rates could be reduced and if it were found to be insufficient, rates could be increased. By this plan the uncertainty would be removed from future estimates and the wisdom of a new schedule of rates could safely be left to the decision of a trial, without jeopardizing the interests of the public or of the corporation.

A general custom in business management is to charge all profit to a surplus account from which dividends are paid. This surplus, then, might well be used as the trust fund suggested. It would receive all profits above operating expenses and depreciation, and would be drawn upon to the amount of a fair return each year. Such a fund would be under the control of the regulating body and could be properly accounted for.

The operation of the trust fund plan would be simple. With

the books reconciled to an approved valuation and continued with actual costs, with readjustments at infrequent periods when necessary; with the depreciation allowance treated as a repayment of capital on the equal-annual-payment plan; and with the operating and other accounts under the supervision of the accountants of the regulating board; this plan seems to solve the problem of actually providing the return which is awarded to the utility.

EFFICIENT MANAGEMENT

Equally important with the actual providing of a fair return is the enforcement of efficient and satisfactory service. As the weakness of past systems of regulation has been in the failure to actually provide a fair return, so the fundamental weakness in past requirements for good service has been the lack of incentive given the utility to improve its service. Standards of purity of water, pressure and the like should vary somewhat in different cities and a regulating commission can prescribe limits, more or less definite, to apply to each particular case. In matters of economy, however, the task of supervising the operation of all of the utilities in a state is too great for any organization so far established. Refinements in economy are suggested only to those operating a property or to those making a special study of the plant in question. It is to the utility manager, therefore, that we must look for material improvements in efficiency and, to enlist his efforts, an incentive must be provided.

In competitive business the standard for plant improvement is economy. If an old machine can be replaced by a new and more modern one, at a saving in annual cost fixed charges and depreciation included, good business dictates that the improvement shall be made, as by so doing the net earnings of the business will be increased. Consider now the position of the utility manager in such a case when his plant is operating under the present accepted methods of public control. The commission probably does not know that the old machine can be profitably discarded, so the change would be voluntary on the part of the company. Rates have been fixed on the basis of present plant value and operating expenses, and the utility is getting a fair return. If the manager discards the old machine he must furnish capital for the new one, and it may be that there has been an insufficient allowance for the depreciation of the old one. His assets, therefore, are likely to be reduced by the

change and his only reward for his trouble and expense is a decrease in operating expenses and a consequent increase in earnings. If the regulating body had allowed him 7 per cent return he may have increased this to $7\frac{1}{4}$ per cent by increasing his plant efficiency. But the commission has only allowed him a 7 per cent return and his efforts have, therefore, entitled the public to a reduction in the rates which, when accomplished, will leave the utility where it began.

Another phase of the same difficulty is the effect of developing the business. In general, the larger the amount of business done by a utility per capita of population the lower the rates may be to produce a fair return. Public welfare, therefore, dictates that the utility business of each community should be fully developed, both for the reason just mentioned and also because the prosperity of a community bears a close relation to the efficiency and widespread use of its public utilities. Yet, on the fixed-percentage-of-return system of regulation, the enterprising manager who, by skill and labor, builds up the business of his company gains no advantage over his brother in the next city whose business has been less fully developed.

It is obvious, therefore, that the common practice of awarding a fixed percentage of fair return takes away from a utility manager all incentive for improving his property, except that which may be furnished by his pride in his own plant or by the orders of the governing board on matters which come to their attention.

The only practical solution of this problem is to put a premium on efficiency by giving the utility a share in the results of its labors. If improvements in a plant produce savings, both the public and the utility should benefit. The saving to the public can be cared for by reducing rates and the share to which the utility is entitled can, perhaps, best be provided by varying the percentage of fair return allowed.

In the application of the method of a graduated-fair-return, the normal fair rates must first be fixed for the particular plant under consideration. The utility would then be permitted to earn an increased percentage of fair return only on condition that rates be lowered below the normal. To illustrate, let us assume a water works plant for which a 7 per cent fair return has been provided, by means of a sliding scale of rates varying from 10 cents to 30 cents per thousand gallons. The application of the variable return principle would then permit the utility to earn a $7\frac{1}{2}$ per cent return,

when they had given the consumers a discount of 5 per cent on their bills; and 8 per cent return when the consumer's discount reached 10 per cent and so on. These figures are used purely for illustration and the writer does not know if they even approximate the scale which should be adopted. The proper scale can only be found by careful study, but the principle seems to be right and it appears to be practical of application. It is earnestly hoped that efforts will be made to adopt some such plan as this in order to overcome the fatal lack of incentive for increased economy which is inherent in the present systems of utility regulation and which is opposed to the interests of both the public and the corporations.

Another thought, which comes in connection with the question of a graduated fair return, is the possibility of adopting standard rates throughout the entire district controlled by one regulating body. This suggestion is offered merely for discussion by those interested, but seems to the writer to merit more consideration than might at first appear. A public utility is a business and it is, therefore, only reasonable that business acumen in the selection of a desirable field of operations should receive some reward. The tendency of most of the methods of regulation seems to be to put all utilities alike on the basis of property value without regard for the cost of the service furnished.

Utility properties differ widely in desirability from the standpoint of cost of production. Some water works plants must filter their water and pump it twice; others must pump from a lake or well without filtration, and still others have water delivered to them under pressure, from flowing wells or springs. With competition, in the same locality, the plant whose cost of production is high would be driven out of business. Under a system of fair return on property value, however, no distinction is made between plants whose cost of production differs on account of the characteristics of the community. The wisdom of this policy is open to question as the utility is not called upon to share any of the burden of high cost of production, where such is found, nor is it permitted to benefit by the low rates, where the cost of production is low.

The solution of this problem seems to be the consideration of the effect on fair rates of the value of the service to the consumer, and the adoption of standard or normal rates, combined with a graduated fair return, might be the answer to the question. In the application of this principle, the city favored by conditions which

promote economical production would enjoy low rates and these, in turn, would increase the percentage of fair return to which the utility would be entitled. In a city where production cost is high the reverse would be true, and in both cases the utility and the public would share in the hazards and profits of the business.

It is believed that this plan merits careful consideration and the writer hopes that the suggestion will bring out discussion on the subject. It is probable that distinctions would need to be made between cities of different sizes and perhaps in other ways, but even a partial standardization of rates would simplify the work of the regulating board and would permit an intelligent comparison of rates in adjacent cities.

CONCLUSION

The subject of this paper is a broad one and the questions involved are large and difficult. The discussion of these problems has been lengthy and it may not be amiss to emphasize, by a brief summary, the more important suggestions which the writer desires to present for consideration.

1. Capital accounts should show the true value of the property and this value should preferably be approved by the body by which the utility is to be controlled.

2. The depreciation allowance should be considered as a repayment of the capital invested, all new construction and replacements being charged in full to capital, and the annual allowance being deducted from capital accounts and used in any way in which the company is permitted to use capital. The amount of the annual allowance should be figured on the equal-annual-payment-plan.

3. Provision should be made so that a utility will actually receive the fair return and depreciation allowance which is awarded to it. This may perhaps best be accomplished by regarding the surplus as a trust fund out of which the utility will be paid the earnings to which it is entitled.

4. Incentive for economical management should be provided, in addition to the well accepted requirements of satisfactory service. This can be accomplished by providing for a fair return percentage which will vary with the change in the costs of service to the consumer. This principle may perhaps be developed still further by the adoption of standard normal rates throughout an entire

state or district, so that both public and corporation may share in the advantages or disadvantages of the utility business in each community.

5. The treatment of all of the problems involved in regulation is intimately connected with the provisions to be made for assuring the utility that it will actually receive the returns which are awarded it, and the problems of determining the earnings for a utility and of actually providing them must be considered together.

In the forgoing discussion the writer has had the water utilities more particularly in mind, although most of the principles involved are applicable to all publicly controlled enterprises. It is hoped that the suggestions offered will be freely discussed and that the future may bring a better understanding and application of the theories of just utility regulation, to the mutual benefit of both the public and the utility corporations.

SOME FEATURES OF THE ONTARIO STATUTES AND THEIR ADMINISTRATION AFFECTING WATER SUPPLIES AND SEWERAGE SYSTEMS.[1]

F. A. DALLYN, C.E., B.A.Sc.[2]

It is the writer's pleasure and privilege as a Canadian and a member of this association to report progress in the province of Ontario. In reading this paper it is hoped to convey to the association not only some idea of the excellence of the existing statutes in Ontario, but a short summary of the history and development of the clauses affecting water supplies and sewerage systems.

Practically all legislation which places municipal enterprises under control of government commissions is of recent enactment. This is also true of legislation relegating the control of water works and sewerage installations to federal, state or provincial health bodies.

In 1873 there existed no central organization for the administration of public health regulations in Ontario. The authority at that time was vested almost entirely in the members of the municipal councils, who by virtue of their office became health officers. The act relegating authority to the municipal councils would not in this day be considered at all complete. One of the typical sections of that act reads:

> Any two of these officers shall have the right to enter into and upon the premises in the day time for the purpose of examination to see whether they were in an unclean or filthy state.

They had power to order the proprietor or occupant of the premises to remedy the condition; they could also order persons suffering from contagious diseases to be removed to some hospital, when the medical practitioner reported that this could be effected without danger to the health of the patient. There was apparently no regulation whatever respecting water supply or sewerage, although there existed at that time in the municipal act a clause giving power

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to a council to pass by-laws, for preventing the wasting and fouling of public water, and for regulating the construction and drainage of cellars, sinks, water closets, privies and privy vaults.

The Provincial Board of Health of Ontario was not created until 1882 and from that date until 1911 the control of the Local Boards of Health was vested in this central body. This body had a secretary with offices in the Parliament buildings. He had a good deal of executive power, but all plans, etc., relating to water and sewage were left to the board, and decided at the quarterly meetings.

The Municipal Water Works Act of 1882 gave to municipalities rather wide powers. (1) Providing for the control of streams acting as sources of municipal water supplies within a distance of one mile, in the cases of villages or towns, and three miles in the case of a city. (2) Prohibiting the draining of sewage or extraneous matter that would in any way taint or foul the source of a water supply. There is no mention of water purification works in this act, efforts being directed mainly toward exclusion of pollution. Strangely enough no mention of this matter appears in the Public Health Act of that date. The passing of this act in 1882 coincides very well with the period when so much was talked of about the self-purification of streams. Bacteriology at this date was a very young science.

In 1884 the Public Health Act was further amended and provided that:

> Whenever the establishment of a public water-supply or a system of sewerage should be contemplated by the council of a municipality it shall be the duty of the said municipality to place itself in communication with the Provincial Board of Health and to submit all plans in connection with said system to the board.

The board was authorized to enquire into and report upon the plans; copies of this report being forwarded to the municipal council and also filed with the government. This act also contained a general clause which required that:

> No sewer or by-laws for extending the same shall be constructed in violation of any of the principles laid down by the Provincial Board of Health and subject to appeal to the Lieutenant-Governor-in-Council.

It seems rather strange to think that as recently as 1886 such an indifferent character of legislation could exist, although research

assures one that the information existing at this date upon the subject of epidemiology and the control of the pollution of streams was largely a blank as far as useful knowledge was concerned.

The executive health officers of the various municipalities met and formed an association. The activities of this body, which was largely controlled through the Provincial Board of Health, materially influenced the advance of sanitary science. Perhaps the greatest advantage at this time was the manner in which their deliberations included citations of European efforts, especially those of the Rivers Pollution Commission and the Local Government Board, who were doing a splendid work in advancing legislation and publishing information along these lines. In considering the amendments of this period one must remember that very little exact information was forthcoming until the reports from the Lawrence Experimental Station were issued in 1891, 1892, and 1893 and these for several years remained largely in the hands of the laboratory workers.

In 1895 the act was further amended, and required municipalities to furnish, together with the plans of the proposed works, an analysis of the water from the proposed source. The analysis was a chemical one and the water was reported upon largely according to old albuminoid standards. The act recited that "where the Provincial Board reported against the supply it should not be lawful to establish such works." The jurisdiction of the board was increased; the board was now permitted to suggest changes in connection with the plans submitted and its decision became binding subject to appeal to the Lieutenant-Governor-in-Council.

It was not until 1906 that the act was amended and a clause inserted making it unlawful to discharge sewage, drainage, domestic or factory waste, excrement or other polluting matter of any kind whatsoever, which either by itself or in connection with other matter corrupts or impairs the quality of any water supply. A penalty under the act was set at $100 for each conviction and each week's continuance after notice was set out as constituting a separate offence.

The most forward step of the legislature was taken in 1911 when it was enacted that the chief health officer, who was also the secretary, should be the executive officer of the board and at intervals between meetings of the board should perform such duties and acts and have such powers as are by the act vested in the Provincial Board of Health. To those of you who are interested in the adminis-

tration of legislation such an amendment can be seen to be of the utmost advantage. Applications from municipalities can now be considered as soon as received instead of being held some times for several months for a quarterly meeting of the board. The act was further reinforced and a section added reciting:

> That no by-law shall be passed for the raising of money for water and sewerage purposes until the proposed water supply or sewerage system, as the case may be, has been approved by the Provincial Board of Health, and such approval has been certified to and signed by the chairman and secretary of the board.

It provided that the preamble of the by-law should recite such approval.

During 1911 and 1912 the Public Health Act was carefully revised, drawn by Mr. John W. S. McCullough, M.D., D.P.H., the present chief officer of health, and was passed by the legislature in 1912. One important amendment stands out and provides that

> 96.—(1) Where the Provincial Board reports in writing that it is of opinion that it is necessary in the interest of the public health that a water works system or an adequate water purification plant, or a sewer or a sewerage system, or an adequate sewage treatment plant, should be established or continued, or that any existing water works system, water purification plant, sewer or sewerage system, or sewage treatment plant, should be improved, extended, enlarged, altered, renewed or replaced, it shall not be necessary to obtain the assent of the electors to any by-law for incurring a debt for any of such purposes.

A further clause was added to the act requiring municipalities to make reports to the board of such information as may be required by it, on forms to be furnished by the board. This clause was especially arranged to apply to both water works and sewerage. The wording of the clause respecting submission of plans was slightly altered and made to apply to extensions of existing systems as well as to new systems.

In 1914 the act was further modified to permit with the approval of the Provincial Board of Health the sewage disposal system of a muncipality to be continued into or through or to be situate in any adjoining township municipality. The act provides that before approving of such work the Provincial Board of Health shall give notice to the clerk of the township that such application has been made, and shall hear all objections before granting approval. After the approval has been granted the municipality receiving such ap-

proval is permitted to expropriate and arbitrate the value of the lands the same as if the work had been situate within the limit of the municipality. An interpetation of this clause indicates that damage by reason of the location of the works will not be allowed.

The Ontario Railway and Municipal Board is a body which is empowered by the legislature to validate certain classes of debenture issues. Owing to carelessness in municipal government many illegal debentures have been sold at one time or another in perfectly good faith. Purchasers of such debentures on being made aware of the irregular character of their holding naturally desire to validate them; to make this possible certain powers of the legislature were delegated to the Ontario Railway and Municipal Board. The municipal act was amended in 1914 to provide for irregularities in water and sewage debenture issues. This amendment reads:

> In the case of a by-law for raising money for any of the works or apparatus mentioned in sections 89–94 of the Public Health Act the board may upon presentation of a certificate by the Provincial Board of Health approving the said works, grant a certificate approving the by-law notwithstanding that the certificate of the Provincial Board of Health was not obtained prior to the passing of the by-law or that the by-law does not contain the recital of such approval.

This sub-section was made retro-active since 24th March, 1911.

It is also of interest to note another amendment of the municipal act of last year, which recites:

> That where under this or any other act power is conferred on a municipal corporation to borrow money for any purposes without the assent of the electors it shall include not only the power to borrow money to issue all debentures but also the power to agree with any bank or person for temporary advances to meet the expenditures incurred from time to time for such purposes.

The recital of legislation is usually a rather dry affair to those of us who are interested in getting things done. The lack of legislation is a terrific handicap, and it was largely with the idea of presenting you a complete record of the legislation in Ontario that this paper was prepared. As you will see that legislation began in 1873 with the power distributed and vested entirely in the municipal bodies. This has gradually been withdrawn step by step and conferred upon a central body and has been reinforced in such a fashion as to make it effective. Naturally one asks is there any real advan-

tage in such centralization of power. Personally when it comes to a matter of handling town planning and civic developments it seems to be perfectly apparent that centralization is almost imperative. The difficulties that disappear with centralization of power are those of improper administration, limited information and biased opinion.

It was discovered shortly after the passing of the Ontario Public Health Act that its administration required not only a first-hand knowledge of municipal conditions and finances, but also an intimate knowledge of the problems associated with sewage and water purification. To make possible this latter an experimental station for the examination of water and sewage and purification processes was erected in 1909 and has been operated since that date. At this experimental station graduate students in the engineering courses and in medicine are given the opportunity of doing post-graduate work, for which they receive a nominal salary. Their energies are controlled by the Provincial Board of Health and their work is mainly directed to research in the operation of purification units and apparatus. The legislature grants an appropriation each year for this work.

Some few months ago, in order that further advantage might be taken of the control exercised by the Provincial Board of Health and to assist in reporting upon extensions requiring the approval of the board, standard regulation and application forms were designed in the office of the board, one for water and one for sewage. These forms were referred to some seven of our representative city engineers for comments before being approved as a regulation under the act. In arranging these forms the endeavor has been to ask of the designing engineer such information as should rightly be in his possession when designing work of this character. To careless engineers the information required seems to be rather burdensome, but to those who have introduced an orderly habit into their work it causes no inconvenience whatsoever. It is the intention of the board to circulate the information received through municipalities, so that in a general way they may be informed of what their neighbors are doing, as well as the current prices obtained for different classes of material. It appears to the writer that the general result of this supervision will be towards the standardization of all work of this class in the province. Such a consummation is one which we all know to be to the utmost advantage of all concerned. Efforts of this kind must needs be slow in their onward march. Advances

which threaten to centralize power are not as a rule well received by the uninformed.

It has been, and will continue to be the endeavor of the Board of Health of Ontario to make this centralization of power, especially with reference to the control of works pertaining to sewage and water, more in the nature of coöperation than autocracy.

THE CHOICE OF ALLOYS FOR WATER WORK DESIGN

By Horace Carpenter

In the design of water works equipment, the engineer makes use of the various noncorrosive metallic alloys only to such extent as the inaccessibility of the equipment or the danger of interruption of service render it imperative to use some material other than iron or steel. Consequently, the amount of such material has, in the past, been slight in comparison with the magnitude of other materials entering into such work, and the engineer has been content to accept, largely without question, such alloys as were commercially available, without any extensive study of the applicability of any particular alloy to the purpose for which it was to be used.

The increasing magnitude of such work, however, makes the proper selection of alloys of increasing importance to the engineer, and it is the purpose of this paper, not to attempt to set forth in detail any fixed rules to govern selection, but to open the way for discussion and to bring forth the results of the study of others who have been able to make a more detailed study of the matter than has the writer.

Alloys are used for water works construction in two forms:

1. *Castings.* In this form they appear in parts the shape or purpose of which is such that it is possible for the material to pass directly from the foundry to the point of application, with only such intervening fabrication as tends in no way to alter the structure of the material, or to change its physical characteristics.

2. *Bars or tubes.* In this form these alloys must, in nearly all cases, be so fabricated after leaving the foundry that their structure and physical characteristics are materially changed. This fabrication consists of forging, rolling, extruding or drawing.

The ideal alloy must possess three characteristics which, in the order of their relative importance, may be classed as follows:

1. The material must be able to withstand, for an indefinite period, the disintegrating action of the elements with which it is to come in contact, this action taking the form of corrosion, erosion, or electrolysis, either or all of which may be present.

2. The material must be of such structure that it will successfully withstand disintegration due to the failure of its component parts to retain their original relation one to another, and must be free from internal stress which will produce progressive failure entirely independent of any exterior agency. This latter requirement implies a composition capable of successful fabrication under existing commercial conditions.

3. Since the materials are comparatively costly, it is desirable that the physical characteristics be as high as practicable in order that the desired result may be obtained at the least expense.

It is desirable to bring to your attention four of the classes of alloys, and to consider briefly their ability to fulfill the requirements of the above specifications, as follows:

The bronzes, or copper-tin alloys.

The brasses, or copper-zinc alloys.

The copper-nickel alloys, and

The nickel-steel alloys.

The bronzes are of ancient origin and, in slightly varying composition, have been used for many centuries. The most commonly accepted composition today appears to be that of the so-called "naval bronze," consisting of 88 per cent copper, 10 per cent tin, and 2 per cent zinc.

Castings of this alloy fulfill the requirements of the foregoing specifications in a very satisfactory manner. They are noncorrosive in the presence of nearly, if not all, the elements with which they are ordinarily brought in contact, they are easily obtainable, of a homogeneous character under ordinary commercial conditions, are stable and constant in physical characteristics, and the material is one that works well in the ordinary machinery operations.

Their physical characteristics are sufficiently high so that apparatus does not need to be unwieldy or unduly heavy in design to obtain the requisite strength under any ordinary conditions. A tensile strength of 30,000 pounds per square inch, a yield point of 15,000 pounds and an elongation of 15 per cent in two inches can easily be obtained.

Rigid adherence to the composition as given above does not appear essential. The copper may be reduced to 85 per cent, with a corresponding increase in the zinc content, or with a corresponding addition of lead without materially changing the ability of the resulting casting to resist corrosion and without material change in its physi-

cal characteristics. In fact, in the presence of sulphur the addition of lead appears to aid the resistance to corrosion.

Where the material is to be used as a bearing metal, as in the seats of large gates, a considerable variation in the composition is desirable. The United States Reclamation Service has worked out for this purpose two alloys to be used in opposition to one another, as follows:

82.8 per cent copper, 4.8 per cent tin, 4.4 per cent zinc, and 8 per cent lead.

82.7 per cent copper, 7.1 per cent tin, 5.3 per cent zinc, and 4.9 per cent lead.

Experiments by the writer, while indicating the impracticability of attempting to confine the composition as closely as indicated, demonstrate that alloys of this nature containing about 5 per cent lead in one and 8 per cent in the other, with corresponding differences in the tin content, were very satisfactory for the purpose.

Alloys of the above nature may be used for castings only as their high tin content makes it impossible to hammer, forge, roll or draw them successfully, so that, where rods or tubes are required, the content of tin must not exceed 2 per cent, and most manufacturers hold to a maximum of $1\frac{1}{2}$ per cent.

Where conditions of design require greater physical characteristics than shown by the bronzes, or where forged, rolled or drawn forms are required, the engineer commonly resorts to the brasses, of which there are an endless variety, many of them of little value, but of which a number have proven highly satisfactory.

For castings of this character, manganese bronze has been very generally accepted and has given very satisfactory service. A characteristic casting of this material shows a composition of about 56 per cent copper, 40 per cent zinc, 1 per cent tin, 1.27 per cent iron, and 1.8 per cent manganese. It will be noted that the manganese content is small, and it does not appear essential that the analysis of the completed casting show any such content, the manganese being introduced in the form of the ferrous-oxide to act as a flux, and any residue being due to an overdose of the flux, and such residue should not exceed 2 per cent. Such castings, properly made, can be relied upon to show a tensile strength of 65,000 pounds, a yield point of 35,000, and an elongation of 20 per cent in 2 inches. Certain manufacturers use vanadium in the place of manganese, and the resulting castings are of the same general character as

manganese bronze. Castings of this material where purchased in small quantities are generally somewhat more expensive than those made of the bronzes referred to above, and it is the general experience that founders unused to the casting of manganese bronze experience considerable difficulty in obtaining satisfactory results. Where the quantity, however, to be used on a job is sufficient to appeal to founders experienced in handling the material, most excellent castings can be obtained at a price generally from 10 to 12 per cent less than corresponding castings of tin bronze.

Forgings, rods and bars of these alloys show very satisfactory noncorrosive properties and physical characteristics considerably greater than the cast material, the exact amount depending on the size and manner of fabrication, and would appear at first glance to be ideal substitutes for similar steel products. Unfortunately, however, the demand for such rods and bars is of such recent origin that the art of fabrication does not seem to have advanced to a point where the product can be guaranteed against failure by disintegration, or by breaking or cracking without apparent cause. These failures in many instances have not manifested themselves until some months after the material has been fabricated and has passed a most rigid inspection, and have been entirely independent of any load thrown on the material. While no satisfactory solution of the causes of, and no remedy for such failures, have as yet been found, it does appear that the same are caused rather by the methods employed in rolling or drawing than by the composition of the material itself. It would, therefore, appear wise to exercise considerable conservatism in the selection of such rods, until the manufacturers have further perfected themselves, and have solved the various problems of temperature and rolling methods, and to use in their stead some of the brasses which have been manufactured for a sufficient length of time so that the engineer can feel comparative security in their use. Among these there appear Muntz metal, an alloy of 60 per cent copper and 40 per cent zinc, which in the larger sizes of rods can be depended upon to show a tensile strength of at least 40,000 pounds, and Tobin bronze with a tensile strength of 55,000 pounds, which together with other closely allied alloys are readily available.

Comparatively recently, one of our largest manufacturers of rods has produced an alloy containing about $57\frac{1}{2}$ per cent copper, 40 per cent tin, $\frac{1}{2}$ per cent lead, $\frac{1}{2}$ per cent iron, and $1\frac{1}{2}$ per cent nickel,

which possesses high noncorrosive properties, together with physical characteristics equal to or slightly superior to Muntz metal. This material is produced in bars and rods.

Tubes made of an alloy of 86 per cent copper and 14 per cent tin are extensively used in the navy in condensers, where they come in contact with salt water.

The most prominent copper-nickel alloy today appears to be Monel metal, a natural alloy containing about 60 per cent nickel, 36½ per cent copper, and 3½ per cent iron. This material has been very successfully used both in the form of castings and rods for large and small work. Its physical characteristics are at least 65,000 pounds ultimate, 32,000 pounds yield, and 25 per cent elongation for castings, with the ultimate and yield points at least 10 per cent higher for rolled rods. Noncorrosive tests indicate that it is not acted upon by either the acids or alkalies as found in construction work. It has been somewhat extensively used for propellers for battleships, both by this country and by foreign countries. It is also used by many valve manufacturers as a seat metal for valves, for use with high pressure and superheated steam. It is also used in the form of forgings for valve stems for high pressure steam and water valves.

This material has not been in use for a sufficient length of time to determine its noncorrosive qualities under all circumstances, but every indication points to its entire acceptability. It is a comparatively costly material, probably costing in its various forms about 50 per cent more than the corresponding brass or bronze material, but its greater physical characteristics in many cases make this increase more apparent than real. It appears to require considerable skill on the part of the founder to obtain sound castings of Monel metal, and the unsuccessful attempts of some such have prejudiced many against its use.

The value of nickel-steel alloys for members under tension, as valve stems, has not received sufficient recognition by the water works engineer.

While unquestionably not possessing the noncorrosive properties of the brasses or bronzes, a proper steel alloyed with from 20 to 25 per cent of nickel does possess such properties far in excess of ordinary carbon steels and combines with this property physical characteristics such that it should demand the careful consideration of the engineer.

In 1905 the Department of Water Supply, Gas and Electricity of New York City specified for valve stems a nickel steel to contain not more than 0.05 per cent phosphorus or sulphur, between 0.21 per cent and 0.41 per cent carbon, and between 21 per cent and 24 per cent nickel and to have a tensile strength of at least 80,000 pounds, yield point of 40,000 and an elongation of 22 per cent.

One of these stems when examined after five years' service showed no indication of corrosion of that part immersed in water, and only slight pitting of that part exposed to air.

There appears to be very little data available showing the effect of various corrosive substances on alloys. Unquestionably many of the manufacturers of such materials have experimented to a considerable extent on such material, but there appears to have been, in the past at least, a dislike on their part to make public the results which they may have obtained. There are appended to this paper a few results of comparative tests that have come to the attention of the writer and which, while by no means complete or conclusive, may be of some assistance in the selection of noncorrosive alloys.

THE CORROSIVE EFFECT OF MOIST EARTH ON ALLOYS AND STEEL

Six test pieces were imbedded in a box of rich earth, which was kept moist with water and occasional additions of $\frac{1}{2}$ per cent solutions of chlorides of sodium and magnesium. The weighed specimens, consisting of rods 15.2 cm. long by 1.2 cm. diameter, presented about the same area to the corrosive influences in the soil. After having been subjected to the conditions provided for a period of six months, the specimens were taken out, washed, dried and reweighed. The loss in weight represented the amount of corrosion in each case.

SAMPLE	ORIGINAL WEIGHT	LOSS IN WEIGHT	PER CENT LOSS
	grams	*grams*	
Manganese bronze	171.87	0.16	0.09
Tobin bronze	162.11	0.19	0.11
Monel metal	160.76	0.19	0.12
Manganese bronze	161.65	0.19	0.12
Muntz metal	163.85	0.55	0.33
Steel	139.58	1.45	1.04

All the specimens showed the effect of more or less oxidation on the surface, the Monel metal presenting the least change in appearance as a result of corrosive action.

CORROSION TESTS ON CAST MANGANESE BRONZE AND CAST MONEL METAL

Relative corrosibility, as indicated by resistance to solvent action of acid solutions and acid solutions containing dissolved salts.

Small specimens of each metal about the same size and weight (35 grams, with length and diameter of 1.2 inch and 0.5 inch) were subjected to the action of 100 cc. of the solutions, in covered glass beakers, for ten days, at room temperature. The specimens were then removed from the solutions, washed, wiped, dried, and reweighed, the percentage loss in weight indicating the degree or extent of corrosion.

Corrosive or solvent action of 10 per cent solution of sulphuric acid

	Loss per cent
Monel metal	0.096
Manganese bronze	0.018

Corrosive action of 10 per cent sulphuric acid, containing iron sulphate

Monel metal	0.32
Manganese bronze	0.37

Corrosive action of 20 per cent solution of hydrochloric acid

Monel metal	0.21
Manganese bronze	7.34

Corrosive action of 20 per cent hydrochloric acid solution with common salt in solution.

Monel metal	0.31
Manganese bronze	1.64

Comparative Corrosion List of Various Alloys

Duration of test 6 months

	COPPER	ZINC	LEAD	TIN	IRON	NICKEL
Alloy A	57.7	40.1	0.44		0.46	1.3
Alloy B	62.6	36.1	0.20	1.1		
Alloy C	62.7	35.1	2.20			
Alloy D	61.0	38.1	0.20	0.5		
Alloy E	89.0			11.0		
Alloy F	54.3	27.0	0.10		0.10	18.3

Solution No. 1 Sea water.
Solution No. 2 Ammonium chloride, 20 per cent solution.
Solution No. 3 Ferrous sulphate, 10 per cent solution.
Solution No. 4 Sulphuric acid, 10 per cent commercial.
Solution No. 5 Swamp water,
Solution No. 6 Sodium hydroxide, 10 per cent solution.

ALLOY	SOLUTION NO. 1		SOLUTION NO. 2		SOLUTION NO. 3	
	Loss in weight, grams per sq. in. of surface	Appearance	Loss in weight, grams per sq. in. of surface	Appearance	Loss in weight, grams per sq. in. of surface	Appearance
A.....	0.0184	smooth sound	0.3790	rough sound	0.085	smooth sound
B.....	0.1364	smooth sound	4.2460	pitted, disintegrated	0.091	smooth sound
C.....	0.1590	etched sound	3.5980	very rough disintegrated	0.092	etched sound
D.....	0.1390	etched sound	5.4530	very rough disintegrated	0.093	smooth sound
E.....	0.1700	etched sound	6.8080	very rough	0.089	etched sound
F.....	0.0660	rough lengthwise cracks	0.5611	rough deeply pitted	0.041	etched lengthwise cracks

ALLOY	SOLUTION NO. 4		SOLUTION NO. 5		SOLUTION NO. 6	
	Loss in weight	Appearance	Loss in weight	Appearance	Loss in weight	Appearance
A.....	0.102	etched sound	0.0030	smooth sound	0.0270	smooth lengthwise cracks
B.....	0.110	etched sound	0.0014	smooth sound	0.0300	smooth sound
C.....	0.132	etched sound	0.0043	smooth sound	0.0180	smooth sound
D.....	0.107	smooth sound	0.0117	smooth sound	0.0270	smooth sound
E.....	0.147	etched sound	0.0020	smooth sound	0.0320	corroded sound
F.....	0.063	etched sound			0.0045	clean sound

THE PRACTICAL VALUE OF PUBLICITY TO THE WATER WORKS MAN[1]

By S. C. Hadden

Occasionally an engineer performs a valuable service by bringing together in one paper data bearing upon a certain phase of engineering science which previously were scattered through engineering literature. It has occurred to the author that he might perform service to the water works fraternity by considering in this paper the value of publicity to water works men and the agencies available for securing it. The thoughts mentioned, therefore, are not brought forward as fresh discoveries, but are submitted in the nature of a review. All of the activities here mentioned have been successfully practiced by some engineers and some engineering societies, but so far as the speaker knows these matters have been very generally neglected by water department officials and by the water works associations.

For the purpose of this paper the water works man is defined as one who gives his entire time to the operation of city water works. Some of the thoughts brought out are not equally applicable to all water systems without regard to ownership, but the limitations imposed by the form of ownership are obvious and need not be indicated in detail.

For the purpose of being specific let us take the case of the superintendent of the municipally owned water works, and consider some of the publicity measures he can adopt to the advantage of himself, of his department, and therefore of his city: (1) The preparation of readable annual reports. (2) The preparation of pamphlets on special subjects for distribution among water takers. (3) The preparation of reading matter for publication in the local papers. (4) Formal advertising. (5) Circularizing selected lists of prospective customers. (6) The making of addresses before gatherings of people in the locality served. (7) The holding of departmental meetings.

[1] Read before first annual meeting Illinois Section, American Water Works Association, March 10, 1915.

(8) The use of hand bills and posters. (9) Identification with and participation in the activities of associations of water works men. These points will be taken up for brief discussion in the order named.

ANNUAL REPORTS

The annual report of the average water department bears evidence of hurried and compulsory preparation. It is perfunctory, lifeless, uninteresting and of small value. Usually it is composed largely of statistical matter presented in the form of tables. Such matters as extensions to the distribution system are recorded almost as minutely and as faithfully as the surveyor records the results of his surveys. Thus the extensions of mains, the installation of hydrants and valves, etc., are tabulated in the published report which, as an exchange, goes into the majority of the municipally owned plants in the country which are of enough importance to get out a report in exchange. Through this agency, therefore, the water superintendent of a town in Utah can learn, if he wants to, the exact location of every hydrant in any large city of Massachusetts having a publicly owned water system. But such information would be so useless he probably would not take the trouble to familiarize himself with it. For reasons clear from the foregoing statements and illustration the average report has little value as an exchange. Moreover, tabulated statistics of the character mentioned possess only small interest to few persons in the home community. These statistics should be filed, but the expense of their publication is unwarranted.

Potentially the annual report is an important publicity agency. Some life should be put into it. The report may well begin with an interesting running account of the important activities of the department for the year. This should be prepared with a view to its publication in local papers. The report should give specific information of general interest to others in the business and to active-minded people in the home community. Some things which fulfill this specification are: Special reports made during the year by outside experts; the making and results of special studies and tests by department employees; summaries of statistics in standard form; descriptions of the handling of problems presenting special difficulties and having somewhat spectacular features, a concise description and history of the water system; numerous photographs

of works finished and under construction; a discussion on the use and abuse of the water system in the home, etc. Such matters would make a report both readable and instructive, and would quicken the citizen's interest in and appreciation of the water works of his city.

PAMPHLETS

A number of water departments have made use of pamphlets to instruct consumers in the proper reading of water meters, and a few have adopted the same means to curtail the waste of water in lawn sprinkling. A notable example of the latter class was the pamphlet issued by the water department of a western city, a few years ago, on the making and care of lawns. The superintendent realized that consumers were using altogether more water than was necessary in lawn sprinkling, and he got out the pamphlet to show people that water alone, even a flood of it, will not make a good lawn. This is a publicity measure which may well be adopted when the water supply is limited, or the pumping facilities inadequate on peak load, and where flat rates are in force. Of course with a fully metered and ample supply, properly determined rates, and adequate pumping facilties there is no occasion for limiting the use of water in sprinkling. The speaker has believed for some time that where it is desirable to limit the use of water for lawn sprinkling, experiments might well be made on grass plats on the pumping station grounds for the purpose of determining the proper amount of water to keep grass green and growing under local conditions of soil, temperature and precipitation. Such experiments would soon furnish a dependable guide to the man who wants to use just enough water to keep his lawn in good shape. The pamphlet furnished the proper means of recording the results of such experiments.

NEWSPAPERS

The newspaper furnishes by far the best publicity medium in a community. Articles should be written in popular style and their acceptance for use is assured. The average local newspaper is hungry for copy and the editor will gladly run readable articles pertaining to the design, construction and operation of the local water system when these matters possess news value. It is a mistake to suppose that newspapers want only highly sensational

matter. They would give more space to engineering matters but for the fact that the staff reporter lacks the technical knowledge requisite to the preparation of articles on engineering works. Someone in the water department should write these articles when anything is to be gained by their publication. When funds are wanted for water works betterments the newspaper columns should be used for the stating of arguments favorable to the improvement or extension of works. This phase of the subject presents such large possibilities that no effort can here be made to cover it except by suggestion. The two thoughts of major importance are that nearly everybody reads the newspapers and that editors are willing to publish any sort of solid information if it possesses news value. The suggested uses of the newspaper also make for friendly relations between the editor and water officials. Surely this is a desirable condition.

FORMAL ADVERTISING

The modern water system is, in a sense, a manufacturing plant of which the product is pure water. The sale of this water produces the revenue. While comparatively few cities have competing water systems, very few public supply systems enjoy a complete monopoly. There are usually numerous competitors in the form of shallow wells. Here is a case where it is to the public good for the large concern to crowd out all the small ones. It is not only the business but the duty of the water official to sell his product to the exclusion of all similar products of inferior grade. All surface wells in cities are polluted or are constantly liable to pollution. They should be closed and an effective method of accomplishing this result is by advertising the good quality of the public supply and the poor quality of shallow well water. In so far as this is a business matter it should be handled by business methods. Advertising copy should be prepared, showing analyses of the competing supplies, and published in the local papers at usual space rates. This has been successfully practiced in several cities. In the *Proceedings of the American Water Works Association for 1910* there is a paper by Mr. Dow R. Gwinn entitled: "Advertising the Water Works Business." This is a most interesting and valuable discussion of this form of publicity. It should be read frequently by managers of both municipally and privately owned plants. As Mr. Gwinn pointed out, water works advertisements are of two types: commercial and educational, but

the latter must, in the nature of things, be a help to the former. Household conveniences such as bathroom facilities, kitchen sinks, and water motor washing machines may be mentioned as items to advertise from the commercial side. Under the educational side good will, among other things, can be built up.

CIRCULARIZING LISTS

In any locality it is not a difficult matter to obtain a list of the names of the householders who are within easy reach of the distribution system of the public water supply but who are using shallow well water. This list, in part or in its entirety, can be circularized to advantage. Circulars should be drawn up to show the superiority of the public over the individual supply, giving data on cost of service, relative purity of the two supplies, the convenience of having, at all times, water under pressure in the house, etc. These circulars may be either mailed or delivered by an employee of the department. This publicity measure possesses the considerable advantage of reaching surely and directly the persons who constitute the department's best "prospects" for new business.

ADDRESSES

There are times when publicity through addresses before gatherings of the people will be helpful to the water official. Again let us suppose that an election is to be held so that the people can vote on a bond issue for water works improvements. At such a time if there are any speech makers in the water department they should seek an opportunity to address such bodies as chambers of commerce, civic associations, and clubs of all sorts. Even the high school classes may be addressed to advantage, for in these times many of the high school age have already enjoyed much greater educational advantages than did their parents and their influence at home is, therefore, out of proportion to their age and general experience. At times of rate revision addresses are also helpful. This form of direct appeal is, of course, a very effective publicity measure. In ordinary times an occasional descriptive lecture on the history and construction of the local water system before an actively interested body is always worth while.

DEPARTMENTAL MEETINGS

The progressively managed municipal water department of San Diego, California, has recently secured considerable publicity at home and throughout the country by holding what might be termed a school for water works employees. The department does all its construction work by force account. Considerable work of this character is now going on and several hundred men are employed. The superintendent has caused to be held monthly meetings at which all the employees get together for the purpose of getting better acquainted and in order to familiarize each of the bureaus, into which the department is divided, with the work done and the methods employed in the other bureaus. Thus a study is made of the procedure within the department from the time a request for material is issued until the material is delivered on the ground and ultimately placed in the improvement for which it was ordered. At these meetings the various construction foremen and other employees of corresponding rank in other bureaus read papers in which they record their experiences and the methods they employ in handling the work in their charge. The men take a keen interest in the meetings and the results obtained have considerably raised the efficiency of the department. Good fellowship is also promoted, as it brings the men and foremen together, oftentimes eliminating imaginary grudges. The superintendent gets in direct personal touch with the various employees by means of these meetings. The papers read are good; those the speaker has seen are in quality fully up to the average paper before the smaller water works associations. Of course each meeting is reported in the local papers and good publicity is thereby secured. Effort toward self-improvement is universally commended in individuals and the same must be true of water departments.

HAND-BILLS AND POSTERS

Hand-bills have been used in emergencies to supplement newspaper announcements advising consumers to boil the water. They have also been used in house-to-house canvasses for the purpose of curtailing the waste of water from defective plumbing and careless use. Posters have been used for emergency purposes as stated for hand-bills. They have also been used for advertising purposes. Thus in one city where the water works had to compete with shal-

low, private wells, crayon sketches on large posters were drawn to show how the water in such wells becomes polluted from various causes. These posters were conspicuously displayed on bill boards in various parts of the city. In general, hand-bills and posters should be used only for the purpose of supplementing other publicity measures.

IDENTIFICATION WITH WATER ASSOCIATIONS

Some publicity usually comes through local papers to the water department which sends a delegate to the convention of a water works association. This is the best evidence the community could have that its water department management is endeavoring to keep up with the times. So much for the department. As for the delegate as an individual there can be little doubt that if he attends the conventions regularly and takes an active interest in the proceedings he is safeguarding his future in the business. The thoughts he takes to the convention strengthen him with others in the business; the thoughts gained at the convention and taken back home tend to fortify him in his position in his community.

PUBLICITY WORK BY WATER WORKS ASSOCIATIONS

Delegates to water works conventions, as is the case in all other engineering society meetings, are rather prone to say that the public should do thus and so. The trouble with this practice is readily illustrated. Suppose the subject under discussion is the neglect or incompetent operation of small filtration plants. The average delegate knows these plants are often, perhaps usually, handled to poor advantage. The fault is said to lie with the public and this is true, but the fact should be stated directly to the public; that would be education. When a water works man tells one or a group of his contemporaries that small filter plants are often abused, he states a thing they all know and deplore. That is commiseration, not education. It seems to the speaker that there has been too much of this. There can be no doubt that the associations have always been willing and anxious to educate the public and they have accomplished much by indirect methods. Much more could and should be accomplished by direct methods. The author believes the American Water Works Association should have a publicity committee whose function it would be to prepare matter pertaining

to the water works business for publication in newspapers. Such a committee would increase immeasurably the usefulness of the association. Thus let us suppose the association feels that small filters are too often neglected. Then the publicity committee should prepare short articles on that subject and send them to newspaper editors in towns having such filters. That seems the best way to bridge the gulf which now lies between those competent to teach and those who need instruction.

Again the public needs to learn the importance of having trained men in charge of water works operation. College training is not implied in that statement, for the man who has had years of practice, supplemented by the proper amount of reading and study, is a trained man in the sense here intended. This is a matter the suggested publicity committee might well work upon. It is not so essential that municipal plants be taken out of politics as that trained men be appointed to take charge of them, and educational work along this line is certain to be productive of much good to the water works business. Even politicians can be made to see that the appointment of trained men is a vote catching medium.

As stated earlier in this paper, in discussing newspaper publicity, editors will gladly accept for publication such matter as the suggested publicity committee would prepare. In the process of handling this matter the editor would become well informed and could be depended upon, in the majority of cases, to bring the same subjects up again in his editorial writing.

All the water works associations are seeking new members. In this connection it is interesting to note that the membership of the Cleveland Engineering Society increased over 50 per cent within two years after the appointment by the society of a publicity committee. This is a remarkable rate of growth for a society over 30 years old. Publicity work, such as suggested for the American Water Works Association, will surely add many new members each year.

DISCUSSION

MR. DOW R. GWINN: The speaker listened to Mr. Hadden's paper with much interest, as he is a thorough believer of publicity in the water works business. The average customer has very little idea of the difficulties which the water works men must meet in supplying water. If our customers knew something of the problems that we are compelled to solve, they would be more charitable with

their criticism and would pay their bills with better grace. It is good policy to take the public into your confidence and let them know what you are doing.

Mr. Hadden very kindly referred to the paper which the speaker presented to the American Water Works Association at the New Orleans convention in 1910 and, by the way, he has a number of extra copies of this paper which he would be pleased to furnish to anyone who is interested.

Mr. Hadden has well said that the best publicity medium in a community is the newspaper. While the speaker would not confine publicity work to newspapers, he believes that the major part of the money spent along this line should be used for newspaper advertising. We have contracts with our daily papers for a 1 inch advertisement for every day in the year, so that the company is always represented in every issue of each of the daily papers published in the city. We have about forty different ads which are used for this purpose alternating from day to day and when the entire lot is used, they commence over again. Some of the ads read as follows:

Give up the back-breaking pump,
Use Filtered Water.

City Water in Terre Haute
is purified by scientific
methods in charge of an expert.
It is tested every day.

Filtered Water Kitchen Sink—
6 Room House—1½c per day.

Don't be tied to the Pump.
Get City Water in the Kitchen.

Good Morning: Have you
used Filtered Water
This Morning?

Pure Filtered Water
Bath Room in 6 room house
3¢ per day.

The Good Landlord puts
City Water in Kitchen and
keeps his tenants

The Public Be Pleased.
We strive to make City Water
Service as near perfection
as possible.

Sometimes we use a half page; sometimes we use a whole page, and on one occasion, we used a double page, when we used a large cut showing how well water is contaminated from privy vaults. We pay special attention to the headlines, some of which are as follows:

The Public Be Pleased.
Come on in, the Water's fine.
Don't be tied to the Pump.
Get on the Water Wagon.
Fix up the Old House.

We have used quite a number of cuts and on several occasions, used a large cut running across the page, showing the park at the pumping station and a portion of the buildings, with the headline,

THE HOME OF PURE FILTERED WATER

We have used some posters, but as stated, believe that the best results can be obtained by advertising in the newspapers.

About four years ago, we did considerable circularizing. First, we went through the street index in the local directory and checked off the addresses of all who were using city water and found that there were over 4000 premises along the line of our mains that were not using water from us. We then prepared a half dozen circular letters, which were printed on the mimeograph and the addresses put on with the typewriter. The typewriter ribbon corresponded very closely in shade and color to the ink used by the mimeograph and the letters had the appearance of being typewritten. These letters were mailed to more than 4000 people and were accompanied with a circular on colored paper, with attractive type and, in some cases, with cuts. The letters were sent out about a week or ten days apart. One man came in and said that he had received three of our letters and was ready to put in city water. He was the head of a large institution which uses $250 to $300 worth of water a year.

One of the best things that we sent out in connection with these circular letters was a pamphlet entitled "An Important Trial," which purported to be the trial of Mr. City Well and Mr. Privy Vault. It was gotten up in legal style and attracted a good deal of attention. To those who are interested, the speaker will be pleased to send a copy of this pamphlet.

In addition to the publicity work already mentioned, will say that we believe that a good way of getting the public familiar with what we are doing is to have them visit our pumping station. Working along this line, we engaged a landscape gardener, spent hundreds of dollars for trees and shrubberies, fixed up a tennis court for the use of the public, and really have a very beautiful park at our pumping station. We invite the public to use our tennis court and to have picnic lunches at the plant. On several occasions, we have invited the local medical society to visit the plant and have served supper. We have also had the Young Business Men's Club, the Manufacturers' Club, and also the city officials. Some of the

teachers in the public schools have taken their classes to the plant and Professor Bruce, who has charge of the chemistry class at the State Normal School, makes a point of taking each of his classes to the pumping station and gives them a talk on the Purification of Water.

Accepting an invitation from the Manufacturers' Club, the speaker gave them a talk on the Methods of Testing Meters, the Purification of Water and Results Obtained. He had a number of charts, showing the daily average bacteria in the river water and in the filtered water, and also the reduction in cost of water to residence consumers who were on meters.

There is another method of publicity which we use that brings good results: Our bills are payable quarterly and at the beginning of each quarter, for a period of ten days, we have a notice in the paper to the effect that "Water bills are now due and payable. Pencils to first comers." We buy 50 gross of lead pencils at one time at $3 per gross, or a trifle over 2 cents apiece. They are first class lead pencils, coated with white enamel, with gilt top and rubber and inscribed in gilt letters, "Compliments Terre Haute Water Works Co." "Pure Filtered Water—Low Rates." These pencils are distinctive and when one takes out a white pencil, practically everyone present knows that it is one of the water works pencils, and an expression frequently heard is "I see you have paid your water bill." The beautiful white enamel is suggestive of the purity of the water, while the gilt letters suggest that the water is good as gold.

As these pencils are given out from the first to the eleventh, at the time the quarterly payments are due, the people have learned that it is better to pay their bills promptly and get a pencil. When bills are not paid promptly, we must send a notice by mail with a two cent stamp and envelope, making the cost equal to the cost of a lead pencil. Hence, we believe that outside of the value as an advertising medium, we are getting a good return on the investment.

In our city, where water can be secured from the ground at a nominal expense, it is necessary to educate the people: to show the advantages of using water under pressure, and also the danger of contamination of water taken from the ground on account of the large number of privy vaults. One day a man came into the office and wanted water for sprinkling purposes. We suggested that he also should take the water for domestic use, but he quickly replied

that he had a good well, the best one in that part of the city, that people came from several blocks around there to get water from his well. We asked him if he had ever had the water analyzed and he said no, that the water was all right; it was clear and nice and cold and it was not necessary to have it analyzed. We offered to furnish him with a barrel of salt, free of cost to him, if he would put it in the privy vault and then if the water from the well became salty, he would know where some of it was coming from. He refused to accept the proposition and when we pressed him for a reason, he said it might spoil his well.

The average water works man will want to know if advertising the water works business pays and in reply, the speaker will say that when he came to Terre Haute 14 years ago, the company had about 2000 customers, after being in the business for 27 years. We now have about 7000 customers and the gross earnings are more than double what they were 14 years ago. Of course, all of this increase is not due to advertising, for we have made a point of serving a very high grade of filtered water. We have an unusually good plant and are getting fine results in the way of bacterial reductions. We have a laboratory and make daily examinations of the filtered and unfiltered water. Good water and good service attract business, but advertising is a material help in developing business.

ANCIENT AND MODERN ACCOUNTING FOR PUBLIC UTILITIES[1]

By Edward A. Pratt

The title "Ancient and Modern Accounting for Public Utilities" might presuppose starting with by-gone ages, but those words were selected because "ancient" books, forms and accounting records have but recently been prescribed and insisted upon by a public utility commission in one of the states of progressive and up-to-date United States of America.

With the hope that the utilities of Illinois may see what burdens may be placed upon them by those holding political positions, the thought of appearing before you came, and time in preparing this address has been taken from a very busy life. What must be done in Illinois is for the public utilities to demand and secure forever their personal liberty of keeping their individual accounts on the best books and forms they can find or design, provided that each and every item of receipts and expenditures shall be recorded according to a uniform classification and distribution. The annual reports of all utilities proper to be compared one with another, must be similar and uniform to the minutest detail, and all made according to every requirement of the Public Service Commission of the state. Uniformity of classification and annual reports must be insisted upon by the state of Illinois and complied with completely by every public utility in this state.

"Ancient" account keeping was "single entry"—a record on a stone, piece of bark, wood, etc. Occasionally now we hear single entry urged, when one playfully tells another to "Put it on ice" when no intention of payment is indicated. Answering an oft repeated question, "single entry" means the recording of a charge or a credit in one place without a counter balancing credit or debit. This system permits of unlocated errors and provides no balancing of accounts to prove accuracy.

When double entry was originated, a two column book called a

[1]Read before first annual meeting, Illinois Section, American Water Works Association, March 10, 1915.

journal was used, so that the left column might contain the debits and the right column the credits. The double entry ledger was also designed back in those ancient days. Both of these forms have almost entirely disappeared from modern account keeping, but another state has prescribed and insists on the use today and in future of these forms, which are almost identical with the books our great grandfathers purchased at the corner grocery.

Here are drafts of these ancient forms prescribed for the use of modern utilities which use tungsten lamps, telephones and typewriters. Why should not this State Utility Commission, with equal right, prescribe tallow candles, and that all messages be written in longhand and sent by messenger. Does not this illustrate the danger in delay in making yourself heard before forms are prescribed rather than be forced to use unsuitable forms or fight for the right afterwards to use your own modern accounting forms and specially designed records?

Right here let it be known that the State Public Utilities Commission of Illinois has repeatedly expressed their policy as not to even recommend forms and systems. They will provide forms for annual reports and carefully written instructions covering the classifications of accounts and analysis of receipts and expenditures. Let us hope they will always adhere to that policy, which they will do if urged to do so by the utilities of this state. Personal liberty must be expected and demanded.

The Interstate Commerce Commission has provided very complete instructions for many utilities, but does not require the use of any particular forms for keeping the accounts. The following quotation is made from a uniform system of accounts for telephone companies:

> The bookkeeping system here described is suggested for the use of small telephone companies—the use of this bookkeeping system in whole or in part is not obligatory and companies may adopt for the present any bookkeeping system desired for them, if the one chosen will produce the results required by the system of accounts.

Before considering the forms and systems of bookkeeping, let us examine a book of instructions. In this printed instruction book for water utilities issued by a neighboring state, we find many things incomplete, contradictory, and impossible. In the opening lines of instructions, we read:

Operating revenues, earnings from commercial sales. Credit this account with all revenue from water sales to commercial consumers, both where the revenue is dependent on the quantity of water taken as recorded by meter, and where such water is sold at flat rates independent of the quantity taken.

In no place within the covers of this book is the word "revenue" defined. One is left to make his own interpretation of the word "revenue" and to keep his books accordingly. One man may have been keeping his books on a basis of cash received and cash paid. In such a case the "revenue" is made up of the cash received day by day and month by month through the year. Where the flat rate alone prevails, the collections are in advance of service, the cost of providing which is yet to be paid. Where both flat and meter rates are used, part of the cash is for service in advance, and part for the water that has been pumped during previous months. "Revenue" in either case does not coördinate with operating expenses.

The manager of another plant may report as "revenue" such an amount monthly and yearly as closely represents the amount paid or to be paid for water service had and delivered on an entirely different but more accurate basis. He may take one-third or one-sixth of monthly "revenue" from flat rates paid in advance. He may credit "revenue" monthly with hydrant and similar rentals. He may credit as "revenue" monthly a carefully calculated sum for the accrued meter rates, which are payable at a later date, either monthly, quarterly or semi-annually.

Can any proper comparison of revenue and expenses, assets or liabilities be made when the most important element in determining rates and values, namely "revenue," is so incompletely described as to justify such a wide difference in its determination in the preparation of the annual report to the commission?

In this same book, we read the following instructions as to taxes: "This account shall cover all taxes chargeable against the water utilities." Does anyone know whether they should report as taxes for the year 1915 the amount that was assessed as at last April but payable in the year 1915 for the year 1914, as being the taxes for the twelve months to December 31, 1915, or the twelve months to April 1, 1915, using in the report for the year 1915, four months of the 1915 levy and eight months of the 1914 levy? Should a utility report as taxes the amount paid in cash in 1915 as required by the government in the Income Tax Report, or should they report as

taxes for the year 1915, the taxes which are assessed in April, 1915, for that year? Who can state positively what is meant in this printed book of instructions, as the charge against revenue for taxes in making an annual report, and can he be sure that his report can be correctly compared with that of every other water utility in that state?

Pick out one more word—"depreciation," with the instructions appearing in two places. On one page we read:

> Every public utility shall carry a proper and adequate depreciation reserve to cover the full replacement of *all tangible capital* in service—when any building, structure, machine, facility or unit of equipment which, at the time of its construction or installation, was classified as tangible capital, becomes through wear and tear economically irreparable, the substitute therefor, having substantially no greater capacity than the unit for which it was substituted, shall be charged to the depreciation reserve account. When, however, a building, structure, machine, facility or unit substituted has a substantially greater capacity than that for which it was substituted, the cost of the substitution of one of the same capacity as the unit replaced shall be charged to depreciation reserve account, and the remaining cost of actual substitution shall be charged to the appropriable construction and equipment account.

A careful application to the accounting records of these instructions would lead one to charge the entire cost of a new tubular boiler of exactly the same heating capacity as a worn out flue boiler to reserve depreciation account. If the tubular boiler is 25 per cent greater in heating capacity than the old boiler, then 75 per cent of the cost of the new tubular boiler must be charged to depreciation reserve account and 25 per cent to new equipment in the power plant. This would cause the inventory of the plant to show an old flue boiler which had been scrapped and one-fourth the cost of a new tubular boiler, which is then intact and in use. It appears that, in an effort to follow these definite instructions, one would soon have a very tangled plant inventory which it would be impossible for anyone to check up.

In passing, it should be noted that the definite instructions in the first sentence quoted above would indicate that the commission requires every public utility to carry a proper and adequate depreciation reserve to cover the full replacement of all tangible capital in service. Does this mean that they shall set aside a reserve large enough to absorb the value of the entire investment in tangible

capital? If so, when the plant has been all paid for by such charges to revenue account, to whom would the plant then belong? Clearly the definite instructions are not to be followed.

While stating that the proper and adequate depreciation reserve shall be set up by charges "monthly," nothing at all definite is stated as to how one should arrive at the rate per cent of depreciation. To follow this, shall one take an average per cent on the whole plant investment, or must one select different rates for few or many different classes of buildings, machinery, fixtures and equipment? If so, what rate shall one use?

Depreciation is too uncertain a quantity to be explained in a few words so that it may be applied properly by plants of even similar equipment and capacity. A very large factor in determining proper depreciation is the policy of each individual utility in the conduct of the plant, some being careful to keep the plant in first-class condition and others allowing them to deteriorate, in which latter case a much larger annual rate for depreciation must be used.

However, enough of these. They show that uniformity of definitions and practices would keep a number of men busy for a number of years without troubling them with forms and books on which others attempt to follow their instructions. We can now consider the tools of bookkeeping, the books, forms and systems of accounting, ancient and modern.

The single entry bookkeeping records on stone made by the ancient Babylonians and Egyptians remain to this day without record of payment. Later on, wood, paper and other materials were used for keeping accounts and it is a thing to be wondered about how the ancients, especially the very rich ones, were able to keep their accounts when, in these modern days, frequently there is so much difficulty experienced in making books attest the historical facts of a business enterprise.

Among the books prescribed and insisted upon is an ancient ledger very similar to one which might have been purchased at a general store fifty or seventy-five years ago. It is surprising to find this old-style ledger included in the recommendations of the Interstate Commerce Commission, but not prescribed by them. This old ledger is a so-called double entry book, the debits being written down one side of the page and the credits the other side. The result is that 40 per cent of each page is blank paper, for the reason that almost all accounts are one-sided, containing a larger

number of either debits or credits. It is also very difficult to take off trial balances or to check out old trial balances from such a ledger, and there is not room enough in the explanation column to state clearly the reason for the entry, which should be done in every private ledger account.

We have here a modern tab-cut looseleaf, self-indexing private ledger. In the front of this ledger is a cash journal for entry of transactions of a private nature which should not be shown upon the general books of a corporation. They can in this way be kept entirely in the private ledger. Following this, are the regular ledger accounts, which are grouped into assets, liabilities, income, expense and personal accounts. The accounts in this ledger are arranged so that all the assets will follow in proper sequence as will also the liabilities, the income accounts and the expense accounts. This grouping of the accounts makes the trial balance as drawn directly from the ledger a financial statement and an income profit and loss account, if the proper entries are made monthly in all of the ledger accounts.

You will observe also that the ledger page has one date column, one long explanation column, one folio column and finally, three columns for "debits, credits and balance." With this ledger no blank space appears even when the pages are filled, for each line is used. The balance, whether a debit, or credit, can be shown at the end of each month and after each entry if so desired. With this kind of a ledger, one could draw off a balance quickly at the end of any month, even years afterwards and the drawing off of the monthly balance and checking of the current records is very much easier than the ancient ledger described above.

Attention is also called to the tab-cut self-indexing feature of the modern ledgers. With the ancient ledgers, one must first hunt the ledger page of an account by looking in an index, and then leafing through the old style book until the ledger page is found. With the modern ledgers, should one desire an asset account, it is only necessary to lift the asset tabs, place the thumb on the account wanted, because the name shows on the tab at the right hand side, and, with one turn of the hand—open the ledger at the account wanted. This tab-cut feature is of great convenience in a private ledger, even though the postings be comparatively few, but, in a consumer's ledger, the use of the tab-cut ledger leaves reduces the time of posting fully 60 per cent and is therefore of a great economical value.

Next, look at the journal which has been prescribed. It is surely an ancient form and quite unnecessary in modern bookkeeping. Here also are two ancient cash books prescribed, one a general cash book and the other a daily cash receipts book. Here also is another unnecessary book which is called the bank book balance.

The four ancient books referred to can easily be supplanted by two modern books, one an income cash record and the other a bank check register in large utilities, while smaller utilities can use one book, a cash journal, to take the place of the four books referred to above. This, of course, means centralizing the bookkeeping records into one or two forms, reducing the clerical labor, and minimizing the possibility of making errors in one or more of the four books. The arrangement of columns of these modern books makes it entirely unnecessary to use the so-called journal, which has almost entirely disappeared from modern bookkeeping.

Attention is next called to an ancient voucher record, truly so-called because designed with the idea that there shall be a column for every desired classification of expense. Here is the voucher record which has been prescribed. The size of the larger leaves is $17\frac{1}{8}$ by 28 inches and the size of the shorter or inserted leaves is $17\frac{1}{8}$ by $26\frac{3}{4}$ inches. There are over 200 columns in this book. If the leaves were stretched out one after the other, it would extend over eight feet. When opened upon the desk, the pages extend twice twenty-eight or, leaving room for the binding edge, about four feet wide by a foot and a half up and down. Column number 1, superintendent, would probably have but one entry a month and, yet in making an entry in that column, all of the rest of the lines over all of the pages would be blank and, of course, waste paper.

Every distribution of expenditures required in this ancient voucher record has been provided for in this modern voucher record-expense journal which, when open on the desk for use, only measures 28 inches by $11\frac{1}{2}$ inches up and down. This small voucher record has been in use in several utilities and in many mercantile institutions for years and permits of almost unlimited analysis of expenses. This modern voucher record is not limited by the number of columns or the length of the pages, because modern accounting methods provide a chart distribution of expenses. In this way, the chart or account number is entered opposite each item as recorded in the proper column in the voucher record. Further elaboration of the expenses under any classification can be made by simply adding another sub-account number and labeling the charges as made.

With the ancient voucher record, the accounts follow each other across the page. If one wants to know the cost of operation of the steam power pumping plant, one must add the several columns one to another, so also if one wishes the cost of maintenance of the power plant or operation or maintenance of the pumping department or engine room or any other summary of the expenses, a summing up of these accounts must be made from this very large voucher record.

In the modern voucher record expense journal, the footing of each of the columns gives the total expenses into the general classifications provided by the utility commission. The summaries of the sub-classifications are very quickly made at the end of each month, which amounts are carried into the monthly report or trial balance books. The cost of the necessary sheets for a utility of the ancient voucher record would be at least six times as much as the cost of sufficient sheets of the modern voucher record.

Furthermore, and of far greater importance, is the fact that this modern voucher record is also an expense journal. Instructions for its use require that all invoices or payments due for expenses or from material and supplies must be entered in the record each month before closing. After the entry of accounts payable records or vouchers for moneys due to creditors and, including the monthly pay roll, necessary journal entries are made as shown in the voucher record. Here you will find the journal entries such as the following: A debit to steam operation account and a credit to fuel stock account for the number and value of tons of coal consumed during the month. Another entry charges capital investment and credits stock accounts with the value of meters and materials used in setting the same, crediting properly to stock accounts. Likewise entries are made for services installed, for meters repaired and services repaired, for insurance expired or bond interest accrued, for the reserve depreciation when one can find out on what basis to calculate it.

The use of the modern voucher record as an expense journal, makes it possible to get into one book every item of expense properly classified in the month when the expense was incurred, regardless of when paid. It requires only one posting of monthly totals to the general ledger account, and eliminates postings in expense accounts from cash books and the old-style journal prescribed, but now considered obsolete.

Time might profitably be spent in considering the old-style voucher check, which is twice the size of a bank check, when a modern

voucher check can be made to show with sufficient detail the items for which the payment is made and yet be no larger than the usual bank check or draft. We might also consider the very intricate method prescribed for keeping pay rolls and distributing wages to proper expense accounts. There are several forms of different sizes, while modern accounting requires only one pay roll and one weekly or semi-monthly time sheet or card for each employee. The latter are very simple, yet complete forms, which permit of minute analysis and strict adherence to the classifications described by any utilities commission.

And finally let us consider the consumers' ledger, both the old and new forms, for the major portion of the bookkeeping of a water utility consists of correctly recording the charges and collections for water sold to thousands of consumers. This means, in some cases, thousands of individual ledger sheets, or hundreds of pages on which several ledger accounts may be carried.

We have here a very complete ledger form prescribed, but it is an ancient form, because it is not modern. It lacks the tab-cut self-indexing feature, which alone saves fully 60 per cent of the time in making postings and in finding ledger accounts.

This modern tab-cut self-indexing looseleaf ledger is designed to carry in one book all the flat and meter consumers within the limits of the ledger capacity. If the services are carried in numerical order, then the ledgers will be carried in the same order and the consecutive service number will be put upon the tab at the left side so that one may turn almost instantly to any service number, first finding the larger index sheet and then anyone of twenty-seven accounts under each tab. It is recommended that white sheets be used for flat service and buff sheets for meter service, and that these be all filed together. Under this method, every service in every block of the city could be located in the ledger quickly. One could turn to Adams Street, and, following consecutively, find every service tap in the 1300 block South Adams Street. One would see that the first two were meter consumers, the next one was a flat consumer, the next three meter consumers, the next service tap was out of commission, and the next two flat consumers, etc.

If one desires to carry the accounts in any special grouping, it is possible to do so with the modern self-indexing tab-cut ledger and to find any one of the accounts in at least one-fourth of the time that one could find it in the old style Boston ledger or the old-style-loose-

leaf ledger. Since most of the work is done in recording charges and collections, the use of this modern ledger will make a great saving in time of clerks, managers and superintendents where it is installed.

As has been stated previously, the State Public Utilities Commission of Illinois have so far adopted the policy of non-interference with the forms and systems of bookkeeping in use, so long as the annual report can be made out correctly and completely. The utilities in this state will be permitted to make use of any ancient or modern bookkeeping methods, but it is quite probable that, should the commission find out that the expense of account keeping in any utility is much larger than it should be, they would then insist on modernizing such accounting, for the reason that the unnecessary expense will be a charge against income to be paid out of money received from water consumers. Such has been clearly the position assumed in other states. It, therefore, follows that, if the utilities of Illinois shall in future be allowed individual liberty as to account keeping, they must at least make use of the best modern accounting forms and records which they can secure or design and, thus, avoid criticism in their home cities and by accountants for the Public Service Commission. The utilities of this state are to be congratulated that they have such latitude, for, in another state, they are prohibited from keeping accounts on any forms other than those prescribed by the commission or approved by them and this commission have so far assumed the position that the law made it incumbent upon them to provide a uniform set of accounting records and compelled the utilities of the state to use only their forms, thus entirely destroying individual liberty in the use of bookkeeping forms and records.

And, finally, you may justly consider what has been accomplished by those public and private accountants and auditors who have been striving, and will in the years to come, strive to provide the owners and managers of public utilities complete and concise, yet thoroughly trustworthy records of all the operations and financial transactions of each enterprise. It is hoped that professional accountants, as well as the professional engineers, may be recognized for the services they have been rendering in making, not two grains of wheat to grow where one grew before, not two gallons of pure water delivered at the cost of one impure gallon, but who have been providing records of accounts so that one group of figures takes the place of many, and so that one book of moderate uniform size takes

the place of several books of irregular sizes, and so that two books may contain all the important records of a very large utility for two or several years. The saving of time and money in account keeping is of deep interest, but far greater is the value of a set of accounting records so complete that any necessary fact can be found quickly or any needed comparison of one period with another, or one utility with another, be made without delay and in the full confidence that nothing has been omitted from the accounts of either period or utility. Then only can the engineers and managers draw the conclusions based on all the facts.

ILLINOIS UTILITIES COMMISSION AND THE WATER WORKS COMPANIES[1]

By C. G. Bennett[2]

State regulation of public utilities in Illinois commenced as early as 1871 when the Railroad and Warehouse Act went into effect, providing for a commission to regulate these two quasi public businesses. From then on down to a year or two ago, various acts were passed affecting other utilities, such as gas, telephone and telegraph companies, but there seems to have been no attempt on the part of the state to regulate water utilities. This was apparently considered a matter coming under the jurisdiction of the municipality for the reason that the field of operation of a water company is local and confined to the limits of the municipality.

To compile all these special acts into one compact form and further to give the state supervision of all phases of the organization, operation and character of service of every utility, an act was passed in 1913 known as an act to regulate public utilities. This is a most carefully drawn statute and gives the commission it creates a firm foundation upon which to stand when exercising the various powers delegated to it by this law.

The Public Utilities Law provides, among other things, that the commission may establish a uniform system of accounts, must pass on all contemplated stock and bond issues before the securities can be placed on the market; that all mergers, consolidations and reorganizations must be approved by the commission before they become effective, and last, and probably most important, the commission is given the power to determine and make reasonable rates and to establish standards of service. These are but a few of the more important subjects with which the law treats but are sufficient to show the scope of the work that the commission has to do. The utilities under its control are those engaged in the transmission, production, sale or delivery of heat, cold, light, power, gas, oil,

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[2] Read at first annual meeting Illinois Section, American Water Works Association, March 10, 1915.

electricity or water and the transportation of persons or property and transmission of telegraph and telephone messages between points within the state. By the definition of a public utility as contained in Article 10 of the law, plants that are municipally owned or operated do not come under the supervision of the commission and, therefore, municipal water plants have no dealings with the commission. There is, however, at the present time, a bill before the legislature to amend the law and bring all municipally owned or operated utilities under its jurisdiction.

The first meeting of the five commissioners, comprising the administration department of the commission, was held on January 2, 1914, one day after the law went into effect, and the cases pending and docket of the Railroad and Warehouse Commission were taken over. As this is a little over a year ago, the commission is obviously quite young; in fact, one of the youngest of the many similar commissions that are in operation in other states. In spite of the youth of the commission and of the great amount of work brought before it almost from the time of its inception, it has been able to meet the demand placed upon it. The organization of the commission is made up of four departments, namely, the administration, legal, engineering and accounting. Each of these departments has had to carry on the current matters together with the vast amount of detail incident to compiling of schedules, forms and regulations that will be used in the future to expedite the work. This explanation is here given to show the reason why so much of the work the commission is now doing is in the process of development and not available for the utilities. In other words the commission is just a little beyond the formative stage in many of the routine matters, although in utility regulation, it is old in experience.

Before utility commissions came into existence many noted cases of dispute between utilities and their consumers were fought out in the courts, several being water cases. The decisions of these cases have laid down the principles that guide the commissions in their decisions. Now that commissions are handling these cases it does not mean that the courts have no jurisdiction, for any case decided by the commission in this state can be appealed to the Circuit Court. This means that the courts regulate the public utility regulators. One function of the commission is to settle these disputes in the most expedient and inexpensive manner possible.

All complaints that come to the commission are settled in one of two ways, the method being determined by the nature of the case.

Where one or a few consumers only are affected by the decision to be rendered, as the dispute over a water bill or the adequacy of a certain street main, it is put down as an informal case. When the character of the service given or reasonableness of the rate is questioned, the decision, of course, will affect the entire community served. Such cases are put down as formal. This division is made so that the decision can be reached in the shortest possible time and to put all cases through the same channel would not be practical.

Informal complaints are settled by the commission in a way that the name indicates—informally. The consumer's complaint is received, given a number, referred to one of the three departments, legal, accounting or engineering, and immediately acknowledged. It is often evident that the complainant has a mistaken idea as to his rights and in such cases his complaint is disposed of by pointing out wherein he is wrong. More often a copy of the complaint or the substance of it is sent to the water company and a request made that a full statement of the facts be given. The complaint often settles itself at this juncture because the utility and the consumer get together and arrange it to the satisfaction of both. When this is not done and when all the facts have been put before it, the commission renders a decision in a letter to both parties, which decision must be accepted or the matter again brought up and this time as a formal case. Perhaps sixty per cent of the cases coming to the commission are informal ones, but it is remarkable how few of them involve water utilities. Many companies have been taking the letters of the commission on these informal complaints to their attorneys for reply. This procedure the commission has not contemplated and is considered practically a useless expense. All that is desired is a clear statement of the facts surrounding the case, and any officer of the company acquainted with these facts can give the information just as satisfactorily from the staff's point of view as can the attorney. The commission's letters are not written by lawyers and it would not seem that they should necessarily be replied to by lawyers. In other words, this practice is injecting an unnecessary expense into the settling of an informal case, unnecessary from the commission's point of view.

The other, or formal cases usually cover the question of rates or service affecting the community served as a whole. By far the majority are brought by the community because the idea is prevalent that the rate charged is too high, and the parties to the case

are the city and the company. A date is set for a hearing at which both are represented, usually by counsel, and all testimony is recorded. At this first hearing both sides are given a chance to give their views on the matter. Sometimes it happens that the key to the situation has been overlooked, and, upon its being pointed out by the presiding commissioner, and a suggestion made that they adjourn for a time and talk it over, an agreement results that is satisfactory to both parties. A number of water rate cases that threatened to be protracted and expensive were settled in this manner, the commission entering an order based on and containing the terms of the agreement, but the commission not passing on the reasonableness of the terms and rates agreed to. When there is no disposition to settle the case by agreement, and where it is a rate that is in contention, the utility is directed to make an inventory and appraisal of its property following the classification given by the commission.

The city usually puts in a valuation to support its contention, and it, too, is requested to make its valuation on the lines given in the classification. This lists the physical property of the utility under eight main heads, namely, Land, Transmission and Distribution, Buildings and Structures, Plant Equipment, General Equipment, Paving, Materials and Supplies and lastly, Non-Operating Property. Each main heading is subdivided in detail so that there is a place to put every kind of property used and useful to the utility in its business of supplying water. There is not usually much coöperation between the city and the company during the process of settling a rate case before the commission, but when both follow this outline, the valuations presented are easily compared. This saves time on the part of all concerned and as the lawyers and experts employed by each side do not work for the pure joy of it, this means a saving of money.

This classification is but the first step toward making up a set of instructions for the preparation of valuations. The different items going to make up unit costs will be set forth fully. Take, for instance, a distribution system, the main items entering are the cost of the material and the cost of placing it. The cost of material is arrived at by taking the cost of pipe, specials, valves, hydrant and lead at the foundry and adding to each the freight, handling, storeroom charges and cost of hauling to the job. Under the item of labor is included cost of trenching, backfilling, placing, jointing tools and minor incidentals. Both the material and labor charge reduced

to cost per foot and added gives the unit cost of a main, and apparently there is no chance for confusion here. Going a step further, however, we often find two witnesses, both qualified to testify on overhead, may not agree at all closely as to the percentage to be applied. This difference of opinion is apparent only, for, after much examination and cross examination, it is shown that where one witness includes in his percentages the cost of engineering, superintendence, insurance and interest during construction, legal expenses and contingencies, the other is testifying to the same plus a contractor's profit. The first witness has figured his contractor's profit into his unit costs. The commission's aim in preparing these detailed instructions is to avoid just such confusion as this and thereby shorten the hearings down to a minimum, and still give each party to the controversy time to put in all testimony and exhibits pertinent to the point at issue.

A recent valuation submitted to the commission is worthy of note. As an inventory or list of the physical property it was very useful, but as a valuation it is of little help. At the first hearing it was brought out that the value placed on each item represented the utility's idea of the cost new depreciated, or present value, with an addition for overhead and going value. The attorney for the city made the company witness, the expert who prepared the valuation, admit that he knew of no other way to make one that would give less information to the commission. This, however, was not a water case, but is cited here to show what the commission considers the way *not* to present facts.

The correct compiling of financial and statistical statements from the books of the company is equal in importance to a correct valuation for rate making purposes, as a rate cannot be established with either alone. For this reason a detailed memorandum or set of instructions is being prepared directing the utility how to submit with this valuation the following statistical statement: record of gross pumpings for last five years by months, total water sold to metered consumers for the last five years, classification of consumers by amount consumed for the year, classification of private consumers by nature of premises served; also by size of meter, and lastly, flat rate consumers, fixtures installed in each premises and present income from each. Some of the more important financial statements about which detailed instructions will be given and their compilation are comparative balance sheets for the year closing on the date of the

valuation, fixed capital account as of the same date and a detailed statement of operating expenses, revenues together with income and profit and loss account for the last five years ending on the date of the valuation or any other date that may be determined by the commission. Some states have prepared and distributed such instructions for making valuations as have been described, for instance, the Ohio Commission. The staff's idea at the present time is to go quite a little beyond what the Ohio Commission has done in this matter and show the utility just how and in what order the facts should be presented. To do the work in the way the commission has asked may seem a hardship to the utility at the time the work of valuation is being carried on, but if some of the hearings now being held by the commission could be attended, and the great loss of time occasioned by the lack of coöperation or following of the same general scheme could be noted, the most critical would be fully convinced that there is a great need for a uniformity in presenting facts.

When the water and other utilities of the State were asked to file with the commission their schedule of rates, special contracts and franchises under which they operate, it was the first step of the commission toward fulfilling the function for which it was created—the regulation of public utilities. Those schedules have been gone over by the rate department and in some cases conditions found that will be remedied by the help of the commission, but which the water companies have not been able to adjust without creating unpleasant relations between themselves and a few of their consumers. Special contracts giving a lower rate to certain large consumers have in some cases been inherited by the present owners of the utility at the time the physical plant was purchased. As a privilege once obtained is soon regarded as a vested right, it is nearly impossible to demonstrate to the favored consumer that discrimination in his favor is not just. A set of instructions is now being prepared directing just how these schedules shall be arranged and just what the commission will recognize as a rate in force. As stipulated in Section 38 of our law, no utility shall grant any preference or advantage to any consumer. Standing on this and further enforced by the instructions, soon to become an order, the utilities selling water on those inherited and unjustly discriminatory contracts can and, in fact, must abrogate them and put the heretofore favored consumers on the regular rates. In this way the utility is absolved

from any controversy and the conditions are remedied to its satisfaction. One case brought to the attention of the commission showed that a water company was selling over half of its output under special contracts for a rate that did not yield a fair return on the investment and although the utility was assured of this fact, it could not seem to eliminate these discriminatory contracts because they had been in force practically ever since the plant started.

The commission is given authority to establish a uniform system of accounts, and toward this end the utilities were asked to fill out an annual report form sent out about the first of this year. In going over those reports that have come in, over half do not give the information asked for, apparently because the utilities' books are not kept in a way that will allow of obtaining the desired information. A system of accounting that would give this is absolutely essential for the most efficient operation of a plant but it is during the last few years only that water works men have begun to realize this fact. One operator at a small plant figured that he lost several hundred dollars last year because he had to put in a new boiler, but he "guessed" he would make a little money this year or next. A system of accounts has been prepared in tentative form and when put into effect by the various utilities, there is little doubt that the trouble of changing from the present method of bookkeeping, in some cases extremely haphazard, to that prescribed by the commission, will be insignificant in comparison to the benefit received.

The information that the commission will obtain from these annual reports when submitted correctly will be worked up into statistical form and can be obtained by any water utility for the asking. Each can then see just how its cost per thousand gallons pumped compares with the other companies in the State and what will be of more value, how it compares with plants operating under similar conditions. No two costs, of course, will be identical, for local conditions will influence the ultimate result, but an operator, with all these facts in front of him, can analyze his own operating costs and taking into account his local problems, can find out just how he stands. From this it can be seen just how important it is that all the information asked for be given in these reports. This first form contained several pages covering the physical property, but this will be eliminated from subsequent reports and only additions asked for.

A set of general rules for the guidance of water utilities is now being prepared by the staff. These are similar to the rules adopted by the commission covering gas and electric service. These rules will establish the allowable error on water meters, specify the equipment the water company must have for meter testing, the time that a meter can remain in service without a test, the charge the commission will make for request tests and regulations about the kind of test record that must be kept, etc. Before the commission adopts any of these service rules, they will be sent out in tentative form to the water companies and a date set for a hearing at which time any changes that are shown to be necessary by the utilities will be made. After the rules are adopted they will be published and sent out to the water companies in placard form to be posted in a conspicuous place in the business office.

The commission is trying to accomplish for the consumer a satisfactory service, for the utility a fair return on the investment commensurate with the service and a better understanding between the utility and the consumer. The latter is largely a matter of education, for the average consumer does not realize the investment made on the part of the utility to bring water into his premises and the continual outlay necessary to keep the service satisfactory. In one city there is a movement on foot to bring the question of rates to the commission with the request that they be lowered. The leaders of this movement feel the consumers should be given water for almost nothing for they say "the water company gets the water right out of the ground here in the city so why shouldn't we be given the lower rate that we ask for?"

RIVER SAND AS A FILTER MEDIUM[1]

By L. A. Fritze[2]

In the selection of sands for filtration purposes, it has been common practice to use the uniform kinds usually obtained from banks or the sea coast. Bank sands are to be found in different parts of the country, yielding a product which has proved very efficient as a filter medium.

The filter plant proposing to use these screened, sharp sands, generally finds the cost very high, so high some times as to almost make its use prohibitive.

To offset this cost, other sands have come into use, and prominent among them is river sand. If a river sand can be found free from mud and other objectionable matter and of a uniform size, there is no reason why it will not give satisfaction as a filter medium. If clay, mud, etc., be present, its removal may offset the financial advantage and make the bank sand cheaper in the end.

However, in this paper, advantage will be taken of the fact that clean, uniform sand can be obtained from river beds, and our cost data will be based on this product.

In some of the older plants in this country, river sand has been in use for a number of years, with results that are very satisfactory.

In slow sand filtration and rapid sand filtration alike, these cheaper sands have been in service from seven to twelve years, and the results prove that a satisfactory effluent may be obtained.

Since the installation of bleaching powder and other sterilization agents, as an additional aid to purification, the necessity for a sand of such high merit as formerly is not now of such exacting importance. However, the size of the sand must be considered, for one too fine will clog quickly, and one too coarse will not yield a satisfactory effluent.

In rapid sand filtration, the use of river sand has become quite common. Inquiries sent to a number of these plants show that a

[1] Read at first meeting Illinois Section, American Water Works Association, March 10, 1915.

[2] City Chemist, Moline, Illinois.

very satisfactory water has been obtained with a sand one-fourth the former cost.

In Moline and Rock Island, the experience has been the same. River sand has been in service for two years with results which indicate its permanent use. This sand is obtained from the Mississippi River, above the city of Moline. A local sand company supplies the material, collecting it in the following manner. By means of a centrifugal sand pump on a boat, a barge is loaded. This barge is then unloaded at the docks of the company by a stream of water from the sand pump, into the river again. After emptying the barge, the sand is then taken from the river and pumped into the sand bins. By this means of unloading, the sand is thoroughly washed and freed from objectionable matter.

This raw, unscreened product has an effective size of 0.28 mm. and a uniformity coefficient of 2.11. When placed in a filter, the fine powder will find its way to the surface during washing. Unless this powder is removed, the filter will clog very quickly and necessitate an increase in wash water. By scraping the bed and freeing the sand of this material, a medium will be obtained with an effective size of 0.51 mm. and a uniformity coefficient of 1.34. For filtration purposes this sand is very efficient.

The loss due to the discarding of the fine powder will vary with the different sands, ranging from 5 to 40 per cent. The Mississippi sand contains about 5 per cent fine powder, which is very easily removed by washing.

It has been found that the size of gravel used will effect the results obtained with river sand. Small gravel $\frac{3}{4}$-inch to $\frac{1}{4}$-inch was in use for a year, but the results show that larger gravel is needed. To meet this, gravel 2 inches and over was placed next to the strainers to a depth of 9 inches. With the smaller gravel on this bed and the sand on top, conditions are very satisfactory. This filter has been in service six months and to date there has been no packing and strainer trouble.

Likewise in Rock Island, it was found necessary to supplant the fine gravel with the larger material, when the river sand was employed. Using the larger size gravel has eliminated considerable of their trouble.

The financial saving of the river sand over the more expensive bank sands is considerable. The cost of the Mississippi River sand per cubic yard delivered to the filter plant is 70 cents. The loss in

this sand due to the fine powder is 5 per cent, making the actual cost per cubic yard 72.9 cents.

Large gravel to the depth of nine inches is needed to obtain satisfactory results. This quantity represents about nine cubic yards and costing $2.35 per yard, totals $21.15. This cost must be added to that of the sand.

The wash water required to free the sand of the fine powder is 125,000 gallons and costing one cent per 1000 gallons, totals $1.25.

Considering these additional factors, the cost of the river sand ready for service in the filters is $1.47 per cubic yard.

For comparison, selecting a well known bank sand, commonly in use in this section of the country, that from Red Wing, Minnesota, the best grade of filter sand obtained at this place costs $3 per ton or $4.05 per cubic yard. The freight from Red Wing to Moline is $1.80 per ton or $2.43 per cubic yard, making a total cost per cubic yard, delivered to the filter plant, of $6.48. An additional charge of 25 cents per yard must be made for unloading, bringing the total cost per cubic yard to $6.73.

Using the two figures for sand costs as found at Moline, the river sand shows a net saving of $5.26 per cubic yard over the Red Wing bank sand. Thirty cubic yards of sand are needed per filter to make the medium the proper depth, and with the above figures the saving per unit is $158 or $789 for the five 1,000,000 gallon units in the plants.

It has been found that the yearly loss of sand due to various causes is about one cubic yard per filter. With river sand this means an annual loss of $3.65, with bank sand $33.65, or a net saving of $30 per year, using river sand.

Cost records on the cleaning of filters, that is, the removal of the sand and gravel, and the cleaning of the collecting system, show that 120 hours time is necessary for the work, and the expenditure $30. In other words, one unit can be cleaned and the lost sand replaced in the other units for the same amount of money as needed for only replacing the lost bank sand.

It may be said in conclusion that river sand is being used with satisfactory results in a number of filter plants, that the cost is much less than the average bank sand, and that the water works proposing to buy new sand can well afford to investigate the quality and quantity available in their own locality, before purchasing.

WASH WATER SALVAGE AT CHAMPAIGN AND URBANA[1]

By Harold E. Babbitt

The public water supply of the cities of Champaign and Urbana is obtained from deep wells located in the northern section of Urbana. The water is pumped into a collecting reservoir and thence passes through an iron removal plant of the rapid sand filter type, with a nominal capacity of 2,000,000 gallons per day. No chemicals are used in the process of iron removal, aeration being sufficient to cause the precipitation of the iron. Much of this precipitated matter is caught on the sand grains of the filter, and, because of its tenacious or gelatinous qualities, causes difficulties in the operation of the filters. Wide and deep cracks formed in the filtering material similar to mud cracks seriously affect the quality of the effluent from the plant and necessitate the use of large quantities of wash water. A complete description of the iron removal plant of the Champaign and Urbana Water Company was presented before the Illinois Water Supply Association last year, by Professor Talbot.

During the summer of 1914 the amount of wash water used at the plant was estimated at anywhere from 6 per cent to 20 per cent of the nominal capacity of the plant. A figure in the neighborhood of 8 to 10 per cent is probably a fair value. The loss of 150,000 to 200,000 gallons of water per day is equivalent to a little more than the output of one of the wells from which the water is taken. On the basis of the rates charged the consumer for water, it amounts to about $3750 per year. The cost of a well complete for service is about $2000. An appreciable financial outlay would be justified which would save a large portion of this water.

The idea was conceived that by collecting the used wash water in a sedimentation basin the greater portion of the matter removed from the filter would settle out and the water be usable again. As a result a reservoir with a capacity of 90,000 gallons was constructed

[1] Read at the first annual meeting of the Illinois Section, American Water Works Association, March 10, 1915.

in the fall of 1914 and put into immediate use. The cost of this reservoir was $1987, including pump, motor and pump house. This represents a saving over the construction of a new well at the same initial cost, in that the operation, maintenance and depreciation on the reservoir are less than that for a well. The reservoir is successful in saving all but about 16,000 gallons per day, and represents an appreciable financial saving. The financial advantage is enhanced by the greater amount of water rendered available, not always an easy factor to obtain at any cost.

The wash water reservoir is a reinforced concrete structure with monolithic walls. It is rectangular in plan with a depth of about 12 feet, almost entirely in excavation. The location of the reservoir is such as to cause difficulty in its construction. It is six feet south of the collecting or raw water reservoir which was disturbed in making the new excavation. This necessitated extra precaution in the amount and the strength of the form bracing. The difficulties and haste of construction account somewhat for the relatively high cost.

Since its construction the reservoir has withstood the difficult conditions of filling and emptying twice daily in all weathers without signs of deterioration, leakage, or weakness—other than a crack in the floor above the end of the inside footing of the wall next to the collecting reservoir. Indications are that this crack is due to unsatisfactory foundation conditions. Imperviousness in the concrete was sought by making a dense mixture in the proportions of 1 cement, 2 sand, and 4 stone and applying two coats of Ironite after the setting of the concrete. The character of the water is such, however, that no provisions for this purpose were necessary. Cracks of large size would immediately be filled by a gummy deposit of iron successfully stopping them from the passage of water.

The reservoir receives the wash water discharged from the filters at the two daily washings at 8 a.m. and at 4 p.m. The water for washing is drawn directly from the clear water basin and discharged into the filters by an 8-inch centrifugal pump. After passing through the filter the wash water is dosed with 2 grains of alum per gallon, roughly measured, and passes to the wash water reservoir where it is allowed to stand for about two hours. Clarification is rapid, but all the time available for settling is made use of. The supernatant liquid is pumped from the reservoir through a floating suction pipe into the collecting reservoir. Six to twelve inches of slushy material

are allowed to waste into the sewers after each pumping. The actual amount of wash water entering the sewers is thus about 0.8 per cent of the capacity of the plant. The amount of water used in washing the filters is about the same as before the installation of the wash water reservoir.

The effect of settling the water without the use of a coagulant was tried. It was found that about 18 hours settling were required before the water could be pumped back into the collecting reservoir. As better results were obtained from the filters by two washings per day, coagulant was applied to accelerate the rate of sedimentation. The effluent from the coagulated water is clearer than from the non-coagulated, but it seems no easier to handle in the filters.

The effect on the filters of passing the settled wash water mixed with raw water through them has been to increase the loss of head after washing from 14 or 18 inches to 24 or 36 inches, and the head loss before washing from 40 or 60 inches to 48 or 72 inches. The character of the effluent is not detrimentally affected.

In the discussion of Professor Talbot's article, last year, Mr. W. W. De Berard suggested that some of the difficulties encountered by the necessity for frequent washing of the filters with a fire hose or by other laborious means might be overcome by using an additional wash water manifold immediately above the sand layer. Such a grid was constructed by Mr. W. I. Ainsworth, operator of the plant, of old material on hand, supplemented by a few new fittings. The grid is made up of a two-inch wrought iron pipe manifold with $\frac{3}{4}$-inch branches on 11-inch centers. One-eighth inch holes on 5-inch centers are bored on the under sides of the pipe and manifold. The grid covers only one-half of the area of the filter, but because of the clogging of the $\frac{1}{8}$-inch holes by the iron deposits only one-quarter of the area of the filter is affected by the grid. The result, however, has been to obviate the necessity of washing this unit with a fire hose. The loss of head on this filter after washing will increase from 18 inches to 24 inches, in the same time that the adjacent units are increasing from 18 inches to 52 inches. It is planned to install similar grids with $\frac{3}{16}$-inch holes on all the filters.

DISCUSSION

MR. W. W. JENNINGS: Does the reservoir have a hopper-shaped bottom and how often is it washed?

MR. BABBITT: The bottom of the reservoir is a single plane surface sloping from a depth of 12 feet on one corner to a depth of 13 feet on the diagonally opposite corner, a distance of about 40 feet. The reservoir is drained after each washing, the total amount of water entering the sewers being about 0.8 per cent of the capacity of the plant.

MR. W. W. DE BERARD: Before finally putting the auxiliary grid in all of the filters further experiments should be made to learn the maximum spacing permissible between orifice opening and between laterals. Mr. Babbitt reports that the whole filter needs no hand hosing, although one-half of the surface only is covered and further only one-half the holes in this grid are open. It was the intention at Oakland, where we carried out the original experiments for the People's Water Company, to ascertain this point but we never got that far. Would it not be the logical thing to double up the distance between laterals and increase somewhat the orifice openings? This will cheapen the grid cost and make it more likely to be tried elsewhere. It is pleasant to learn that the results of experiments carried on eight years ago are being made use of with such good results.

In passing it may be said that we tried pointing the jets in all directions. When directed in any but downward, sand was shot out over the edges of the gutter. Not much added impetus is required to project a sand grain to the gutter under such condition.

This means of applying the wash water is the only one which the speaker knows that will allow one to take advantage of the jet action, and thus to produce the attrition of one sand grain against another. No filter strainer made produces a jet action more than a very few inches from the orifice. It would be a detriment to the system if it did, for the action would be taking place on clean sand grains. To make jet action effective it must be applied at a point where the dirty sand lies at the top of the bed.

WASTE PREVENTION BY INDIVIDUAL METERS VERSUS DISTRICT METERS[1]

By R. O. Wynne-Roberts

There are many cases where it would be difficult to make an equitable charge for water consumed unless the quantity was measured. These are industries, institutions, premises requiring water in very small quantities for sanitary purposes and large consumers. But the large majority of consumers do not actually need much water, although it is well known that an inordinate quantity is used or misused. This has arisen in some instances from the fact that it was considered more economical to supply than to check, in other cases it is due to indifferent management and neglect until the waste has created serious disabilities on the part of some of the water authorities.

There is now a general movement for the conservation of water and the principal means taken is to install individual meters on all water connections. The object of this short paper will be to discuss the question as to whether the general installation of individual meters or the provision of district meters is to be advocated.

Waste of water must be eliminated as far as practicable and economical, for the keynote of successful management of all business is to stop leaks of all kinds.

A water works system loaded with a high rate of supply is not unlike a ship which has a constantly leaky water ballast, for neither the water works nor the ship can be operated to its full legitimate capacity, nor made to be revenue producing to the extent it should. The proprietors of the water works who propose to install a general meter system so as to reduce some of the leaks may be compared with the shipowners who have some of the leaks in the ship's hull repaired and pumps provided to reduce the water ballast. Carrying the analogy still further, the water works proprietors who install bulk and district meters, a few individual meters and by means of efficient inspection reduce all leaks to a minimum are similar in

[1] Read at first annual meeting Illinois Section, American Water Works Association, March 10, 1915.

purpose to the shipowners who have the ship's hull thoroughly overhauled, and ample pumps provided to keep the water ballast empty. In both these cases the property is maintained in an efficient condition and made to produce the maximum revenue at the minimum cost.

Most of the cities are relatively small and if it be assumed that the average size is about 20,000 population, it will doubtless represent a large number of towns. The unrestricted total consumption is say 150 gallons per head daily. In such a city there would be about 3500 water connections and if all are metered there would be that number to fix and maintain. The water authority to secure full control over the meters would buy the meters and rent them out.

Adopting the careful analysis of costs made by the Wisconsin Railroad Commission and mentioned in their report of 1911, the average annual cost is as follows:

Labor moving and resetting meters		$0.18
Labor meter and fittings department		0.34
Supplies, meter and fittings department		0.12
Maintenance of meter		0.35
Reading meters and delivering bills		1.35
		2.34
To these must be added		
Depreciation, say	$0.50	
Interest	0.36	0.86
Per meter per year		$3.20

The cost of metering will fall on the consumers and in this case it would amount to $11,900 per annum.

The cost of filtered water at the works will be about $3.50 per million gallons.

Individual meters measure the water entering the premises and consequently constitute good waste detectors. The saving in the quantity of water used before and after installing meters varies greatly, but in all cities metering has effected a tangible reduction in the quantity of water pumped. Published figures are often misleading because the diminution in the quantity consumed by the people is often small compared with the losses on the mains. When the total quantity of water registered by individual meters is ascer-

tained, the unaccounted for losses amount to from 20 to 66 per cent of the total quantity pumped. It will be fair to expect 33 per cent reduction in the pumpage by universal metering. Supposing the head on the pumps is 100 feet and price of coal is $4 per ton then the saving in fuel due to diminished pumpage will be about $1200 per annum. The cost of labor will remain practically the same.

District meters could be installed in this city for about $3000, a small number of individual meters would be required as explained in the commencement, and inspectors would be employed to make a systematic and frequent survey of the whole water works. The annual expenditure in this case would be as follows:

Interest on $3000	$150	
Depreciation	150	$300
2 inspectors	$2500	
Clerks, etc	1500	
		4000
250 meters at $3.40		850
Miscellaneous		250
Total		$5400

By careful and diligent inspection the pumpage should be gradually reduced to one-half and the saving in fuel on the same basis as before would be $1800.

The above estimate is liberal. The writer had control of water works and by means of this method was able to supply the public on less than 30 gallons per head daily for all purposes, the railroad companies were large consumers. The London Water Board use from 1300 to 1400 Deacon meters to detect waste and by discovering and localizing leaks the average supply is under 45 gallons per head daily. By means of pitometer survey at Ottawa, Canada, leaks amounting to 5,300,000 gallons per day were remedied in a short time. Washington has in seven years detected leaks aggregating 40,000,000 gallons daily. Three permanent self-recording district meters have been installed in Regina, but systematic inspections have not yet been started. The record obtained from the district meters enable the officials to detect leaks and to localize them and by this means keep the consumption at a reasonable figure. Such meters and records are a check on the pumps and on the daily occurrences in the district controlled.

The reduction of waste is equivalent to increasing the capacity of the water works to meet growing demands and at a reduced cost or with increased revenue.

Even in cities where the rate is fixed by the Public Utility Commissions and individual meters are compulsory, district meters are essential to provide an efficient and economical system. With both individual meters and self-recording district meters the quantity of water necessary to satisfy all requirements should not exceed 50 gallons per head per day, except in special cases where the industrial consumption is abnormally high.

The financial situation as estimated in the foregoing illustrations will be as follows:

Individual meters

Cost of operation.....	$11,900	Saving in fuel.....	$1200	
		Value of water saved.....	$1277	$2477

District meters

Cost of operation.....	$5,400	Saving in fuel.....	$1800	
		Value of water saved.....	$1914	$3714

It will be observed that in the case of individual meters the estimated cost of operation and the savings effected is about $9423, which is equivalent to about $2.70 extra cost per water-paying consumer per annum, whilst in the case of district meters the corresponding figures are $1786 and 52 cents respectively.

BUBBLY CREEK FILTER PLANT ADOPTS LIQUID CHLORINE TREATMENT[1]

By C. A. Jennings

It is interesting to note that seven years ago water purification was accomplished by storage or sedimentation alone or in conjunction with filtration. There were no supplementary purifying processes, such as disinfection, that were on a practical working basis. Today the water works engineer has the choice of two or three supplementary processes, viz., hypochlorite, liquid chlorine and possibly ultra-violet rays. The first two are well established. The third, although it is possibly more practical than ozone at this time and although it has been given serious consideration recently by two or three cities, nevertheless is not yet on an established working basis.

The Bubbly Creek filter plant at the Chicago stock yards set the lead in the use of hypochlorite of lime in this country for water disinfection. This was during the summer of 1908. Several years ago experiments were begun at this plant with an electrolytic cell for the production of chlorine from salt brine. These experiments were carried out very extensively and thoroughly. The writer finally concluded that in comparison with hypochlorite and liquid chlorine, the production of chlorine for water disinfection by means of an electrolytic cell was expensive, uncertain and demanded considerable attention.

Very recently a liquid chlorine apparatus was purchased. Chlorine is received in cylinders that hold 105 pounds of the liquefied gas. From the experience gained by operating this apparatus during the past month, the writer has concluded that, in comparison with the use of hypo at the Bubbly Creek filter plant,

1. There is considerably less labor involved.
2. The absorption of the gas by the water is more rapid.
3. There is no loss of chlorine and smaller quantities can be used to accomplish equivalent results.

[1] Read at first annual meeting Illinois Section, American Water Works Association, March 10, 1915.

4. There is no deterioration of the chlorine in the cylinders while using or while stored.

5. The changing of the rate of application is easily, quickly and accurately accomplished.

6. There is no odor of chlorine about the plant.

7. The cost is considerably less.

There are mechanical features about the Bubbly Creek filter plant which the writer believes are peculiar to it. These features are the enormous amount of hypochlorite necessary to disinfect the water, the poor mechanical means for getting into solution all of the hypochlorite used, which resulted in a large loss of available chlorine, and the last pertinent feature, the irregularity in the operation of the plant due to a varying consumption and small filtered water storage capacity. This often caused it to be necessary to run one or two filters for a time and then suddenly have to use eight filters. Naturally the coagulant and germicide must be proportioned to the amount of water being filtered. Now while using liquid chlorine, the regulation of the germicide is much more simple, accurate and economical than with hypo. The ratio of costs, during one month's operation with liquid chlorine with an average raw water supply and the treated filtered water as low in bacteria as when using hypo, was 1 to 3 in favor of liquid chlorine. It is hardly probable that every plant will show such a large difference in the costs of disinfection by the two methods.

DISCUSSION

Mr. H. E. Jordan: While the average plant using chlorine in some form as a sterilizing agent will not effect the saving noted by Mr. Jennings, the cost in any case will not effect the material advantages gained in ease of operation and freedom from odor.

Water works men have become accustomed to installing hypochlorite outfits in a very crude way, at a low cost. These installations need to be frequently replaced. So in considering the installation of a liquid chlorine plant, many will object to the comparatively large initial outlay. The liquid chlorine plant can be installed in an open pump room or even a plant office, without bad effect upon copper alloy or offense to the persons working there. The improvement in the mental attitude of the employees is a very great item in favor of this method. At the same time, liquid chlorine plants,

while nominally automatic, need attention not only when changing tanks, but under normal conditions the responsiveness of the feed regulation device should be frequently tested. This is no more than is the case in running pumps or any other piece of water works machinery, and is not to be held as a disadvantage of a liquid chlorine plant.

The experience at the East Chicago plant, over a period of a year, is that the system is doing all that could be expected of it in its effect upon the water, and that it operates satisfactorily under conditions that are well nigh impossible of handling with a hypochlorite plant.

C. A. JENNINGS: In order to aid somewhat in analyzing the deductions made as to cost data, it might be added that the liquid chlorine costs us 8 cents per pound f.o.b. Niagara Falls and the freight rate is sufficient to bring the cost to $8\frac{1}{2}$ cents per pound delivered in Chicago. The last carload lot of hypo purchased cost $1\frac{3}{4}$ cents per pound f.o.b. Chicago. The rate of application of hypo has been from 50 pounds to as high as 100 pounds per million gallons. Remarkable as it may seem, the saving in the cost of treatment by liquid chlorine over hypo is sufficient at the present rate to pay for the liquid chlorine apparatus in 100 days.

EXPERIENCES IN REBUILDING AND REËNFORCING A WATER WORKS SYSTEM[1]

By O. T. Smith

It may be well to state, in the beginning, some of the conditions under which the work was done so that a better understanding may be had of the situation. The franchise of the Water Company expired July 1, 1912, and negotiations were begun for a sale or a renewal of the franchise a year and a half previous to that date. The Chamber of Commerce of the city was brought into the negotiations by the city council agreeing to the appointment of a committee of ten of the members of the association to assist the city council in the purchasing of the plant or in passing a franchise. Arrangements were made to proceed under the clause in the franchise which gave the city the right to purchase at its expiration. The preliminary negotiations showed that the city had no power to purchase, but it was agreed that there should be a valuation of the plant, proceeding as though the city could purchase. It was further agreed that the commission required by the franchise should be requested to suggest a proper ordinance which of course included the suggestion of fair rates.

The appraisal was made and the commission's valuation was accepted by both the city and the company. The proceedings of the commission were considered entirely fair by both parties. The city selected an eminent engineer, Mr. F. E. Tuneaure, Dean of Engineering of the University of Wisconsin. The water company chose Mr. John W. Alvord, of Chicago, and the two agreed upon Dean Marston, of the University of Iowa, as the third member of the commission. The commission was required also to outline the necessary improvements and make an estimate of the cost of the said improvements, to place the plant in proper condition to give adequate fire protection and private service for a period of years, the whole to be made a basis for fixing rates and charges.

[1] Read at first meeting Illinois Section, American Water Works Association, March 10, 1915.

Previous to the beginning of the negotiations the company had prepared an inventory of its property under the direction of Mr. Dabney H. Maury. This inventory was accepted by the commission together with a supplementary inventory covering the two years subsequent to Mr. Maury's inventory, made by the city engineer and the writer together. The commission estimated the cost of additional improvements and extensions at $182,000 by the end of 1916. The ordinance as finally passed included these improvements and extensions as a condition of the extension of the franchise for thirty years.

The improvements outlined by the commission were additional high service and low service pumps, additional filter plant, additional boiler capacity, additional storage reservoir, and additional water supply, together with about thirteen miles of mains for the reenforcement and extension of the distribution system. This work was begun in the fall of 1912. Pumps were contracted for, cast iron pipe was purchased, and the work progressed to final completion in the fall of 1914. The work of connecting the new pumps with the old system and the many necessary connections at street intersections were interesting, and, frequently, rather complicated propositions. In most cases the street intersection connections were made by using a cross with a valve on each side of the old main, using a Smith style tapping machine for the work.

In the improvements required were two new river crossings, owing to the fact that the great factory district was on the easterly side of the river. One crossing was a 10-inch and the other an 8-inch. These were in addition to one 8-inch crossing which was in the original plant. To facilitate the work of laying mains the company concluded to purchase a trench machine and decided upon a second-hand machine which paid for itself in the two years operation, several times over. As an indication of the value of this machine; at one time the machine was out of commission for four days and in order to complete an extension before cold weather the gang of men were kept and did the digging by hand. During four days until the machine was again in commission with hand labor with the same number of men, exactly the same amount of pipe was laid that was laid in one day after the machine was again in use. Of course, all situations did not show such results, but there were enough of such jobs to make the purchase of the machine very economical. In making the river crossings a universal joint was

used. Of course, this is not new to you but is of interest, as to the manner in which a small river crossing can be made successfully.

In addition to the work which was specifically mentioned and required in the ordinance, the city under its right to order further extensions, exercised that right frequently during the period of construction, and during the two years and a half which have elapsed the city has ordered and the company has laid about four miles of extra extensions. The basis on which the city may order an extension is considered a fair one. The requirements of the ordinance covering the reënforcement of the system, practically entirely for fire protection, were that the city should pay a certain fixed sum for fire protection covering the improvements, additions, and extensions specifically named in the ordinance, and for additional extensions by the payment of an annual rental of as many cents per lineal foot as equals one-half of the diameter of the pipe in inches plus a specific price for each hydrant placed on such extensions. For instance, if the city orders an extension of 500 feet of 6-inch main and a hydrant, they would pay $15 per annum for the mains and $7.50 per annum for the hydrant. This arrangement has resulted in the city freely ordering extensions where called for by prospective private consumers; and the cheapness of the hydrant rental has resulted in a much more frequent spacing of hydrants which is required by the ordinance and is very desirable.

The financial result under this ordinance has been satisfactory. The changing from flat rates to meters has increased the revenue substantially, while the pumpage has decreased, not to a very remarkable extent, but during the year 1914 the pumpage was less than in any year during the three years previous.

The rates on meter bills are figured by the hundred feet and the maximum rate is for the first 2000 feet per month. The next 3000 feet is at a lower rate and all over 5000 feet is at another rate so that every consumer gets the same rate for the same amount consumed, and the more he uses, the less the rate, automatically.

EXPERIENCE WITH ARTESIAN WELL WATER AT ELGIN, ILLINOIS[1]

By R. R. Parkin

In 1903–1904 the city of Elgin installed four artesian wells. One 2005 and three 1300 feet deep, and after the wells were completed, a shaft 9 feet in diameter was sunk 115 feet deep. At this depth tunnels 5 feet in diameter in opposite directions were run for about 500 feet, connecting the wells and piped each with 12-inch pipe which are run through the tunnels to central shaft and connected to pumps at the bottom of the shaft. These tunnels are built of concrete and very successfully shut out all seapage into the tunnels.

The wells are as near as possible in a direct line from the shaft. After the shaft and tunnels were finished, each well was plugged below the line of the tunnels with a rubber disc held in place by 2-inch pipe from the surface, shutting off the water below the line of tunnels where a 12-inch disc was cut out in the 12-inch well pipe. On this 12-inch pipe was attached a 12-inch split sleeve to each well pipe. A 12-flange valve was also attached, and from each well was connected 12-inch cast iron flanged pipe back to the shaft and pumps.

In sinking this shaft a great amount of water was encountered which resulted in one contractor abandoning the work. After some delay the work was let to another firm who nearly completed it. After some further delay it was decided to assume and complete the work as designed, which was quite successful. This vein of water referred to, coming from the hillside and flowing towards the river, was estimated from 800,000 to 1,000,000 gallons per day. The contractor used every means of his own to keep the water out. During this time, for several days, quite a flow of sand was noticed coming in with the water, which was being raised out in buckets and pump. Warning was given them to stop this flow of sand or stop the work. This was not taken seriously and they

[1] Read at first annual meeting Illinois Section, American Water Works Association, March 10, 1915.

continued until about 3 a.m. when one of our engineers said there was a leak in the filter house. The contractor was at once ordered to stop work immediately. At the station it was found that two filters were out of line. All the damage done was the breaking of a 7-inch flange on one of the filter lines.

After this the work was done under air pressure of about 16 pounds down to about 65 feet, where blue shale was found and no water. Several 4-inch bleeders had been placed in the cement near this water vein, so that in the future they could be connected with our well system and this water used, but as this vein of water was carrying a large amount of quicksand with it, and had undermined the foundations of filters and buildings, it has not been made use of.

The cement was very successfully gotten into place. The air pressure was kept on for about eight days. When the air was released, very little if any water came through the concrete, and the shaft is quite dry at this time. From this time to 1913 this vein of water has been in our minds as an additional source of supply.

Elgin, like most cities, is growing, and its demands for water increase, and have to be satisfied. In 1913 we were obliged, for the first time in twenty-five years, to restrict our consumers in the use of water for outside use. This called attention to the need of increase of our supply, and after advertising and receiving bids for a deep well, which were quite in excess of former bids received in 1904, it was decided to go after this water referred to, and a local well-driller was employed to, if possible, find the vein. One 6-inch hole had been drilled to bed rock; the first drilled being below the reservoirs some distance from the station. In this hole the water did not rise on reaching the limestone. This was rather an experiment, being about 1000 feet from our shaft.

At the second location being quite sure of finding water, and after drilling into the same limestone which underlies our city, water was found which rose about 26 feet above the limestone in the 6-inch pipe. The temperature of this water was 54 degrees.

Several tests were made by pumping from the surface and at 12 feet below. In the tests it was found that 125 gallons could be raised per minute, lowering the head only a few inches. This was done by weir measurement, and with a larger pump 240 gallons per minute were raised under the same condition. With these results it was decided to sink a shaft of about 6 feet in diameter, starting with a square hole to water line. At this line a platform was built

upon which was installed a larger pump driven by 12 h.p. motor, belt connected. This for some days kept the water down so that the men made rapid progress for about 10 feet, mostly in clay. At this depth the pump failed to keep the water down, and another one was procured. After this the work progressed very fast until near the depth of 33 feet when the water increased above the capacity of the pump, and a pulsometer pump was procured, and with the two the water was kept down from the water line. Interlocking steel sheeting was used driven by a piece of railroad iron connected by cable to our hoisting engine. At times when this was hard to drive, a water jet made the driving much easier. Stones were also removed by jetting. It was quite necessary to keep the sheeting 2 or 3 feet below the digging. When too near the bottom the water pressure from below would burst through and choke the suction. The steel sheeting was driven into the limestone which is quite soft and full of water veins, through which the water boiled. After removing several feet of this limestone below the sheeting, a tier of tiles was put in around the bottom one, leaving one out every three feet; where a short piece of 6-inch pipe was used. After these were placed the hole was lined with wooden sheathing allowing a 6-inch space between, which was filled with cement under water through a 4-inch conductor pipe. In this way the cement remained with the mixture. This was carried to above the water line. Up to this line the shaft is round 5 feet 8 inches internal diameter; above this it is 6 feet square. All surface water is entirely shut out. After this shaft was completed one 600-gallon centrifugal pump was purchased. To this we have a 20 h.p. Jenny vertical motor installed at the surface. From tests made since, it shows the pumping to be about 600 gallons per minute, and from present indications will continue to be so, as the head remains about the same.

The analysis of this water made by the State Water Survey pronounces it a very good water.

THE POSSIBILITY OF AN IMPROVED WATER FROM DEEP WELLS IN NORTHERN ILLINOIS[1]

By C. B. Williams

The geology of Northern Illinois is fairly well known from the numerous wells drilled throughout this district, but the quality of the waters supplied by various strata of water-bearing rock has not been so well investigated. Most deep wells throughout this territory supply a water which is a composite, being a mixture of all good and bad water encountered in the sinking of the well.

The distinction between good and bad is not made from a sanitary stand point, as most of the deep well supplies are of unquestioned hygienic purity, but rather from their suitability for commercial and domestic purposes. Nearly all of these waters are unsatisfactory for boiler and laundry uses, as they are extremely hard and often contain objectionable iron salts.

In making a selection among the various strata of water-bearing rock, it is apparent that the lime rock may be eliminated as a medium for producing a soft water, hence we necessarily turn to the two sand rock strata as being the only possible source for a satisfactory water. A study of the general formation of these strata, the nature and conditions of their source of water supply gives a clue to the probable kind of water we may expect to obtain from each.

The Potsdam sandstone lies just above the Archean bed and varies in thickness from a few hundred to over 1500 feet, and is interspersed with layers of limestone and shale. Lying over the Potsdam sandstone is a rather thin, generally impervious blanket of limestone known as the Lower Magnesium. Over this limestone is the St. Peter sandstone usually several hundred feet thick, which in turn is overlaid with the Trenton limestone, Hudson shale and Niagara limestone successively, the latter two having been eroded in the central part of the field.

These successive layers of rock rise gradually toward the north

[1] Read at first annual meeting Illinois Section, American Water Works Association, March 10, 1915.

and west and outcrop in Wisconsin, Minnesota and Northern Michigan. The Archean rock outcrops the furthest north, in a broad irregular area, extends as far south as Chippewa Falls and Wausau, Wisconsin. South of the Archean rock is the Potsdam outcrop in a V-shaped belt covering about 14,000 square miles, the apex of the V extending as far south as Madison, Wisconsin. Next south is an outcrop belt of Lower Magnesium limestone and southerly of this is the outcrop of the St. Peter sandstone in Southern Wisconsin and Northern Illinois, having an area of about 2000 square miles.

These outcrops mostly covered with a pervious blanket of soil and gravel are the intakes so to speak of these sandstone underground channels. The general surface drainage of the main part of this territory of Wisconsin is south and southwesterly, hence the numerous streams crossing the Potsdam outcrop rise in and flow over Archean and sand rock and are less liable to become charged with lime and magnesium salts; on the contrary the streams feeding the St. Peter sandstone have previously traversed the limestone district of the Lower Magnesium outcrop, thereby becoming impregnated with the hardening salts of lime and magnesium.

These observations would lead us to believe that the Potsdam sandstone would furnish a softer water in general than that from any other strata, and as a verification of this, the results obtained from some wells sunk in Cook County are of interest.

The Chicago, Milwaukee & St. Paul Railway Co. and the Chicago and Northwestern Railway Co. have both successfully improved their water supply for boiler purposes, by casing off portions of the waters in their wells. Also the village of Western Springs has sunk a deep well and cased out certain waters, thereby greatly improving its supply, but not to the same extent as in the case of the railroads.

The Milwaukee wells are located on the Chicago and Council Bluffs division, about two miles west of Mannheim. There are at least five, the records of which are available, and all of which show similar characteristics.

The log of well No. 1 following, is typical:

Ground level 679 feet above sea level

		feet		*feet*
Niagara limestone	from	62	to	260
Hudson shale	from	260	to	455
Trenton limestone	from	455	to	785
St. Peter sandstone	from	785	to	1060
Lower magnesium limestone	from	1060	to	1262

	feet	feet
1st Potsdam sandstone	from 1262	to 1450
Limestone, shale, etc	from 1450	to 1705
2d Potsdam sandstone	from 1705	to 1804
Limestone	from 1804	to 1820
3d Potsdam sandstone	from 1820	to 2290

Caves were encountered at 570 feet to 590 feet, 1060 feet to 1070 feet and 1085 feet to 1095 feet. These caves were taken care of by casing. The lower and third Potsdam sandstone is composed of beds of different thickness, color and hardness.

The well is cased from the surface to a depth of 1262 feet where the casing is sealed to the rock walls by concrete.

The following are analyses of the water at various depths below the casing, given in grains per gallon:

Depths (feet)	1450	2030	2128	2290
Oxides	Undetermined	Undetermined	Undetermined	Undetermined
Calcium carbonate	2.94	5.34	6.64	10.22
Calcium sulphate	4.61			3.95
Magnesium carbonate	0.27	2.10	2.87	3.88
Incrustating solids	7.82	7.44	9.51	18.05
Alkali carbonates		7.81	8.92	
Alkali sulphate	7.47	10.50	4.82	3.17
Alkali chlorides	3.38	4.68	12.44	50.96
Non-incrustating solids	10.85	22.99	26.18	54.13
Total	18.67	30.43	35.69	72.18

This well which is the deepest, shows a large increase in incrustating solids toward the bottom, and also a large increase in salt contents. This was avoided in the other wells of the series by lessening the depth by about fifty feet. The yield of these wells varied from 130 to 170 gallons per minute.

The Northwestern Railway drilled a chain of wells at Proviso, Cook County, Illinois, on the Galena Division, about four miles south of the Milwaukee wells. These wells were spaced from three to six hundred feet apart, and all showed similar characteristics as to depth of strata and as to quality of water. The log of well No. 3 is typical.

Surface of ground, elevation above sea level 645 feet

	feet	feet
Niagara limestone	from 73	to 245
Hudson shale	from 245	to 478
Trenton limestone	from 478	to 810
St. Peter sandstone	from 810	to 1010

		feet		feet
Lower magnesium limestone	from	1010	to	1220
Sandy shale	from	1220	to	1320
1st Potsdam sandstone	from	1320	to	1520
Limestone	from	1520	to	1747
2d Potsdam	from	1747	to	1830

Caves were encountered here only between the St. Peter sandstone and the Lower Magnesium limestone. This well was cased to a depth of 1690 feet and was only drilled to a depth of 1830 feet. The following is an analysis from the water at that depth given in grains per gallon:

Calcium carbonate	4.20	
Magnesium carbonate	1.46	
Iron and aluminum	0.06	
Silica	0.46	
Incrustating solids		6.18
Alkali chlorides	4.10	
Alkali sulphates	4.04	
Alkali carbonates	10.08	
Non-incrustating solids		18.22
Total		24.40

This well, as the others in the series, was cased to a greater depth than the Milwaukee series on account of the poor quality of water found in the first Potsdam sandstone. The yield varied from about 60 to 150 gallons per minute, and the pumping of two alternate wells 600 feet apart to a depth of 242 feet lowered the water in the third intermediate well 97 feet.

The village of Western Springs, Illinois, has just completed a well in which the results obtained conform generally to those found in the Milwaukee and Northwestern wells.

This well is ten miles due south of the Milwaukee well in the township of Lyons about one-half mile from the west line of Cook County.

The following is a log of this well:

Surface of the ground, above sea level, 648 feet.

		feet		feet
Niagara limestone	from	73	to	360
Hudson shale	from	360	to	474
Trenton limestone	from	474	to	790
St. Peter sandstone	from	790	to	1244
Lower magnesium limestone	from	1244	to	1337
1st Potsdam sandstone	from	1337	to	1490
Limestone	from	1490	to	1765
2d Potsdam sandstone	from	1765	to	2046

This well was cased down to a depth of 1765 feet as the water from the first Potsdam and underlying limestone was very unsatisfactory, as may be seen from the following analyses, given in grains per gallon:

	Above 1st Potsdam 1337 feet	*1st Potsdam and limestone 1337 feet–1765 feet*	*Below Casing 1765 feet–2046 feet*
Calcium carbonate	21.23	21.46	13.42
Calcium sulphate	3.74	1.11	
Magnesium carbonate			4.80
Magnesium sulphate	15.11	15.12	2.10
Iron carbonate		0.27	0.12
Undetermined	0.55	2.21	0.99
Incrustating solids	40.63	40.17	21.43
Sodium sulphate	2.69	5.45	8.85
Sodium chloride	0.29	0.77	24.06
Sodium nitrate		0.04	
Non-incrustating solids	2.98	6.26	32.91
Total	43.61	46.43	54.34

This well is rather unique in that in placing the casings the one through the drift is made big enough to allow small suction pipes to be dropped between it and the inner casing thus making the water from either the upper or lower strata available. The available supply from the lower strata for a draw down of 150 feet was about 110 gallons per minute.

A study of these three wells bears out to a large degree the assumption that the Potsdam sandstone will give a more satisfactory water than the St. Peter sandstone. It also is evident that all parts of the same stratum cannot be relied upon to give exactly the same quality; this is shown by a comparison of the water from the first Potsdam of the Milwaukee well which shows 7.82 grains per gallon of incrustating solids, while the same stratum in the Northwestern was reported as bad and the Western Springs well showed 40.17 grains per gallon.

It further appears that increasing the depth beyond a certain point will probably increase the hardness without any great return in quantity of water, and that the capacity is limited to approximately 170 gallons per minute, according to the tests on these wells. In the territory around Chicago at least, a limit to the depth is fixed by the increased amount of salt in the lower levels.

More data are needed to establish the conclusions as drawn from these limited cases, and should cover the territory more completely. If, with the increased data, it is found that the above conclusions are generally borne out, it opens up an improved supply for small towns and industrial establishments that may be well worth the extra cost to obtain.

THE WATER SUPPLY OF LONGVIEW, TEXAS[1]

By P. E. Green

This paper is a description of the installation of a new water supply for the city of Longview, Texas. It is not a detailed technical description of this work, though more or less technical data are given, but more emphasis has been laid on the human interest end of the problem because it is believed it is typical of many small towns in the United States, and because it illustrates so accurately the workings of human nature in our average city officials.

The city of Longview, Texas, is a community of about 7000 inhabitants. Up to within the last five or six years it has had practically no public improvements, except an antiquated water works system.

A few years ago a sanitary sewer system was installed under a franchise. Some four years ago this system was purchased by the city, and it is now operated by it, charges being made in a manner similar to that for ordinary water connections. There is a socalled disposal plant consisting of a small sedimentation tank and about 1600 square feet of broken brick filled beds for a filter. Incidentally it may be noted that the city makes a net profit of about 20 per cent per annum on the sewer system.

The existing water supply, before the installation of the one to be described in this paper, consisted of two deep wells, one of them 1200 feet and the other 600 feet in depth. From them the water was pumped by means of an ordinary air lift into two reservoirs, and from the reservoirs the water was pumped by means of two duplex steam pumps of 1,000,000 gallons capacity each, into a standpipe, having a capacity of about 75,000 gallons. The water from the wells is of a peculiar character. It is clear, sparkling, and of exceedingly pleasant appearance. It has, however, a very high chlorine salt content which makes it unsuitable for general commercial and domestic use. A typical analysis of this well is shown:

[1] Read at meeting of Illinois Section, American Water Works Association, March 10, 1915.

	Parts per million
Suspended matter	None
Oxygen consumed	2.8
Organic nitrogen	0.33
Albuminoid of ammonia	0.08
Free ammonia	2.23
Nitrites	0.12
Nitrates	0.10
Chlorine	1160.00
Alkalinity	368.00

From the above it will be seen that the chlorine ran to 1160 p.p.m. Other analyses have shown as high as 1600 p.p.m. The alkalinity is also high, amounting to 368 p.p.m.

The water is decidedly salty in taste, though after using it for a time many people declared that they did not longer notice the taste of salt. On a stranger, its effect was frequently quite laxative, and lawns, etc., were soon ruined if it was used for sprinkling. However, in addition to its character, the supply was very limited, and while, when the wells were first installed as much as 300,000 gallons per day was obtained, this yield steadily dropped and ultimately it was difficult to get more than 100,000 gallons per day out of both wells. About 2000 people are served by the water and sewer system.

In 1911 and 1912 several disastrous fires occurred, during which there was practically no water available, and the mayor and city council, as well as the people generally, appreciated the fact that a new water supply was absolutely necessary. The writer was therefore commissioned to make an investigation of the subject.

There were three sources of supply to be considered: 1st, an artificial lake, known as Lake Lemont, about a mile west of the city; 2d, a small stream called Grace's Creek, running through the city; and 3d, the Sabine River, distant about three miles and a half from the city. Lake Lemont has a drainage area of about seven square miles. The Lake is about a mile long and from a quarter to one-half of a mile in width, and averages about five feet in depth. This lake is used for fishing and hunting purposes only. The investigation showed that its shallowness and limited water shed, together with the long continued dry spells which are characteristic of that part of the country, make it unsuitable as a source of supply.

The investigation of the second project, Grace's Creek, as it was called, developed that there was no available site for a dam, although

the water shed is approximately 25 square miles in area above the town.

This left the river as the only available source. The Sabine River above Longview has a water shed area of about 2900 square miles. The population on the water shed was about 136,000, almost entirely rural. From the very limited government data on the subject it was determined that the minimum flow would be about thirty cubic feet per second. The rainfall averaged about forty inches, and the run off from 10 per cent to 30 per cent. At times several months passed with no rain whatever.

Analyses were made of the Sabine River water, the water of Lake Lemont and of Grace's Creek, of which typical examples are included herewith:

LOCALITY	SABINE RIVER			GRACE'S CREEK	LAKE LEMONT	
	1912					
Date of collection	Feb. 13	Feb. 16	Feb. 28	Feb. 16	Feb. 13	Feb. 28
Date of analysis	Feb. 16	Feb. 19	March 1	Feb. 19	Feb. 15	March 1
Physical analysis:						
Turbidity	60	75	120	40	60	50
Color	75	70	85	70	60	75
Odor	None	None	None	None	None	None
Sediment	Slight	.....	Slight	.....	Very slight	None
Chemical analysis:						
Suspended matter						
Total	23.000	21.00	39.000	7.00	16.000	16.000
Volatile	5.000	9.00	5.000	6.00	3.000	8.000
Fixed	18.000	12.00	34.000	1.00	13.000	8.000
Oxygen consumed	5.300	5.10	6.700	6.00	3.800	5.200
Nitrogen as:						
Organic nitrogen	0.340	0.24	0.360	0.17	0.410	0.520
Albuminoid ammonia	0.120	0.13	0.180	0.14	0.170	0.240
Free ammonia	0.004	0.12	0.016	0.12	0.120	0.088
Nitrites	0.000	0.00	0.000	0.00	0.001	trace
Nitrates	0.020	0.00	0.020	0.00	0.060	0.060
Chlorine	16.000	16.00	18.000	13.00	6.000	7.000
Total hardness	44.000	35.00	33.000	35.00	35.000	23.000
Alkalinity	20.000	22.00	20.000	18.00	22.000	22.000
Iron	1.000	1.00	1.000	1.00	trace	trace

Bacterial investigation showed that all the sources of supply were more or less contaminated, but none seriously. It was therefore recommended that a 1,000,000 gallon mechanical filter plant be built at the edge of the river, some three miles and a half from the city, and the water pumped from there to a new modern elevated tank.

The presentation of the report developed some very lively opposition to the river project. It was commonly stated that during the "black rise" the river was and always would be absolutely unsuitable for drinking purposes, that it would be salty, full of organic matter, etc., etc. This, in spite of the fact that very complete information had been obtained of the water shed, and nothing had developed which would indicate that at any time there would be any great difficulty in filtering the water, though it might be very hard sometimes. It also developed that there was a very strong sentiment in the city for the use of Lake Lemont, the first source of supply mentioned, as the location for the filtering plant. This was because it was so close to the city. However, the report was accepted, leaving the question of the source of supply to be later decided.

After the necessary bonds were voted there was a period of several months in which nothing was done. The bond market was bad, and no serious fires had occurred. As soon as the bonds had been voted the mayor and city council were deluged with letters and visits from promoters of various devices for purifying water, each sure that his device was the only one to secure the result desired, and all of them willing to absorb the cost of engineering in their price, so that the city would not be put to that unnecessary expense. Some of them were backed by very strong local sentiment through business connections, relatives, etc.

After three or four months of this kind of promotion the council was considerably bewildered. They very naturally desired to get the best plant at the least cost. Finally, as a sort of a compromise and with a shadowy idea that possibly there might be oil, since everyone was talking oil in this part of the world, it was decided to sink another well near the site of the old wells. Accordingly, a deep well drilling apparatus and a quantity of iron casing were purchased and a start made on drilling a well. This was soon abandoned and the outfit was later sold to a well drilling company.

About this time there was a small outbreak of typhoid fever in

the city which alarmed the mayor and council. They promptly sent samples of the well water to Chicago and to Dallas for analysis, and these analyses developed the fact that the water was suspicious, B. coli being found by both analyses. It was decided, however, that the cause of the contaminated water was in the condition surrounding the wells, and this condition was promptly remedied, and as promptly it was decided to go ahead with the Sabine River project.

Plans and specifications were then prepared, providing for a mechanical filtration plant of 1,000,000 gallons capacity, having two filter beds, a sedimentation basin of 500,000 gallons capacity, and a coagulation basin of 100,000 gallons capacity. Besides the filter plant proper there was included in the scheme a tunnel intake, two low-lift centrifugal pumps of 700 g.p.m. capacity, driven by 2300-volt, 60-cycle, 3-phase motors. Two high-lift pumps were provided, one, a 750-gallon 3-stage centrifugal, motor driven, and one 650-gallon, motor driven triplex. In addition a steam duplex pump was provided, for emergency high-lift pumping, and a small generator set to drive the low-lift pumps and light the plant in case of failure of the current. The current, furnished by a local company, was taken off at 2300 volts and stepped down for lighting. Alternative proposals were also invited on the filter plant, plans to be submitted by bidders.

Proposals for bids were advertised for and received. Since alternative proposals were possible the field of bids was quite broad. In general the alternatives proposed by the best of the filter companies provided a lesser time of sedimentation than the engineer's plans.

In several small cities in that part of Texas the crude scheme of settling surface water by means of dosing it with alum and allowing it to settle in small shallow circular basins had developed. The dosing apparatus of such a plant had been patented and the patentee, or his successors, had formed a company and sold the device to some active business man of a nearby city. This company, after the bonds were voted, became very urgent in an endeavor to secure the installation of their device, and submitted a bid. This was the only departure from standard practice proposed. It may be said that it was simply an adaptation of the St. Louis system on a small scale, without either the expert supervision or facilities for sedimentation possessed by the city of St. Louis.

The plans for a filtration plant, providing for six hours sedimentation, were finally accepted at a cost of about $5000 under that of the engineer's plans, it seeming to be the unanimous opinion of the able engineers representing the various filter companies that the saving was justified.

The work has now been constructed and is just starting operation, though not fully tuned up yet. The city of Longview, after some three years of strenuous discussion, has now a first-class water supply. The total cost of the intake, filtration plant, three and one-half miles of 12-inch force main, a new 150,000 gallon elliptical bottom elevated tank, pumping machinery, motors, and auxiliary steam pumping plant, is about $150,000, not including engineering.

As yet not much trouble has been experienced in handling the water, though at the time of this writing, February 3, the water is exceedingly turbid, and the alkalinity is very low. After 24 hours plain sedimentation there is no apparent reduction of turbidity. The beds are washed by taking water from the force main, in which the pressure is about 125 pounds. This is a mistake. A wash water tower should have been provided, since the ordinary pumpage, 650 gallons, is not enough to wash. Therefore no checks could be used between the wash water take off and the stand pipe. At the end of the first week of operation, the too sudden opening of the wash water valve caused a surge which sheared off several of the laterals and cracked the header. Gauge readings showed that the force main is subject to a pressure ranging from 60 to 160 pounds as the pumps are stopped or started. To remedy this a relief valve and automatic air valves have been installed.

The usual troubles with air pockets, best places for dosing, etc., have been encountered. It has been found for instance that applying the alum at the low lift pumps produces the best results for very turbid water. The best bacterial results have been obtained when the hypo is added about ten minutes before the filter beds.

Mr. H. N. Roberts, C.E., was the resident engineer in charge of the work and is now city engineer in charge of the operation of the plant.

COOLED DRINKING WATER[1]

By R. F. Massa

The existence of intimate relations between a proper drinking water supply and health is accepted, in a way, by all intelligent people. It is unfortunately true, however, that sanitary, like moral principles, are much more readily accepted as abstract truths than made a part of daily practice.

It is the writer's purpose in what follows to state the principles involved in supplying proper drinking water, and to describe the requirements of such a supply. It is his further purpose to make clear the importance of honoring these principles in the observance rather than in the breach. The material offered for consideration will be presented from the point of view, principally, of the factory manager, but the considerations which govern are essentially those touching the human rather than the purely mechanical element in manufacture, and they therefore have an essentially broad appeal and interest.

Suggestions have been taken from a number of articles that have appeared from time to time on this and allied subjects, as well as from experience, and the passage of time since these articles were consulted has so dimmed memory of the exact origin of many of the points that proper credit will be difficult if not impossible—

"An' what 'e thought 'e might require,
'E went an' took—the same as me!"

There are two essentially fundamental requirements in an efficient drinking water system. In working out such a supply, these two points govern: first, the water must be pure; second, it must be at a proper temperature.

The importance of purity of the supply has been recognized and has been generally insured. Various devices, operated by electricity and by steam, are provided and successfully operated for insuring a proper degree of purity. The final and equally vital problem has been much less successfully met. No matter how pure the water

[1] Read at meeting of Illinois Section, American Water Works Association, March 10, 1915.

may be, if its temperature is not right it will not serve its purpose. It will not be drunk. Further, no matter how pure the water supply may be, if it does not reach the user through means insuring that it has remained pure, a doubt is cast upon its purity amounting, in many cases, to practical certainty that it has been contaminated.

CORRECT TEMPERATURE FOR DRINKING WATER

The range of temperature at which water is palatable is rather narrow. Extensive experience has proven that there should not be a variation of over 5° as a maximum, from 50°. And yet, if one will apply a thermometer to the water supplied by ten drinking water fountains, it will be found in nine of the cases that the temperature is very far from this range.

There is a physiological basis for this preference for water at a temperature close to 50°. According to Dr. Thomas Darlington, secretary of the welfare committee of the American Iron and Steel Institute, water at this temperature stimulates the heart and also has some influence in relieving the internal temperature and equalizing it throughout the body.

ILLNESS FROM LOWER TEMPERATURES

On the other hand, water at a temperature appreciably lower than that named frequently produces cramps, or, if taken in quantities insufficient to produce this trouble in a clearly defined form, it lowers the efficiency of the individual affected, while leaving him in service. There is at the same time a further loss of efficiency in too little water having been consumed, and the whole value of the supply has therefore been destroyed. Water that is too cold is avoided as instinctively as water that is too warm. Tests to determine the influence of temperature upon the quantity consumed indicate a falling off of one-third with a fall in temperature from 50° F. to 40°.

STATEMENT OF SANITARY PROBLEMS INVOLVED IN PRODUCING A PERFECT SYSTEM

Having provided for the purity of the supply, the next question is how to get the water from the point where its purity is assured to the point at which it is to be consumed, with certainty that its purity has not been diminished, and further to deliver it at the palatable temperature.

Troubles from ice

One of the first difficulties encountered has been the problem of cooling. Water otherwise perfectly satisfactory for drinking has been contaminated by adding dirty ice or keeping it in a water cooler that has not received proper attention. This difficulty has in many cases, although unfortunately not in all, led to the use of receptacles in which the water is placed near the ice, or is in some way kept out of actual contact with it. Even though the ice is pure, it is generally handled in ways that are not conducive to cleanliness. Obviously, such ice should not come in contact with the water to be cooled, even aside from the question of temperature.

Futility of bottled waters

The second difficulty now develops: the problem of distribution. The purchase of waters for drinking has greatly increased during recent years, owing to the belief that by purchasing water in bottles or jugs there would be greater certainty of obtaining something that is entirely satisfactory. Some years ago, however, the Connecticut State Agricultural Experiment Station examined a considerable number of samples of such waters, and not only found a number that were not above suspicion, but pointed out that waters from uncontaminated sources might readily become unwholesome if carelessly marketed or bottled in unclean receptacles. The problem of proper cleansing of receptacles is by no means a simple matter.

The Bureau of Chemistry of the Agricultural Department at Washington has also reported an extended series of investigations which show that in many cases when the waters reach the consumer the bottles may not contain the water indicated by the labels, owing to incorrect labelling in the first place, or to tampering with the contents of the bottle on the way.

Even though the purity of the supply and the cleanliness of the method of handling the water are unquestioned, the use of drinking cups at the fountains invariably involves their use more or less in common, no matter what effort there may be toward the requirement of individual cups.

SANITARY SPECIFICATIONS FOR AN IDEAL SYSTEM

The ideal method of supplying drinking water whether in a public building, an apartment house, a hotel, a school or a factory, must aim,

First. At encouraging the use of a sufficient quantity by each person.

Second. The water must be made attractive.

Third. It must be carried from the point at which its purity is assured to the lips of the consumer in such a way as to insure its continuing pure.

Fourth. The drinking fountain should be white and clean in appearance.

Fifth. The water itself should be clear and sparkling.

Sixth. It should be placed convenient to the worker.

Seventh. Its temperature should be regulated and held constantly as close as possible to 50° F.

Quantity of water required per person

The quantity of water consumed by the average person amounts to about 3½ pints per day. Hot weather and exercise increase the demand.

The amount of water that must be supplied for each person in a drinking water system will vary through very wide limits, depending upon the design of the fountain. Usually where the design has been properly worked out the amount runs from one to two gallons per person per day. The larger figure is taken from the results in a large steel works. In schools the figure will often run as low as one-half gallon per person.

Results running up as high as 6 gallons per man and higher are occasionally encountered, but such figures seem invariably to go with defective fountain design or a water supply at a temperature above a palatable degree. Where the fountain is badly designed, there is often excessive waste because so small a portion of the water flowing can be drunk. Where the temperature of the supply is higher than it should be, the man will let the water run, to get it as cold as possible, and will otherwise waste it.

Economy of properly designed bubblers

Contrary to what one would expect, the consumption of water with a properly designed fountain is actually less per person than with drinking cups, where the temperature of the water and its attractiveness in other respects are the same. Tests made by Inspector Dougherty of the Water Department, Washington, D. C., showed definite economy by making the change from cups to bubblers. The reason for this is undoubtedly the effort to cleanse the public cup before it is used and the almost invariable drawing of a larger quantity of water than is consumed.

The design of bubbler fountains

It is obvious that in the design of the drinking fountains, the greatest care should be taken to produce the most efficient possible fountain jet, since the consumption of water varies through the widest limits, as above indicated, according to the efficiency or inefficiency of the jet.

Many of the older designs of fountains seem to have attempted to duplicate natural springs. Even when these fountains are fitted with self-closing valves so that no water flows except when the fountain is being used, only a very small percentage of the water that flows can be consumed. A design very much to be preferred as a matter of economy and of sanitary value is therefore that in which the water issues in the form of a jet. In fountains of this design, where the stream is allowed to rise to a point high enough so that there is no danger of the lips coming in contact with the fountain, the larger part of the water that flows can be drunk. A further advantage of the stronger stream is that it will flush off quickly any dirt that may have been carelessly or maliciously allowed to accumulate at the orifice. In some fountain designs, even this possibility is overcome by arranging a series of very small jets directed obliquely upward toward a common point at which the various jets impinge upon each other and the resultant stream is directed vertically. With this design, and, in fact, with any design, economy is sometimes attempted by cutting down the size of the stream in order to reduce the waste during the moment the man is drinking. This economy is readily carried to a point where it does more harm than good, because too small a stream will

not only waste a slight amount of time, but is very unsatisfactory to drink from.

It should not be necessary to point out the importance of having the shortest possible connections between the circulating system and the fountain so as to reduce the amount of water that may stand in the pipe and become warm. If this quantity of water is appreciable, the employees quickly get the habit of holding the fountain open long enough to insure that the "dead" pipe has emptied itself. Naturally, this means considerable waste of water and of cooling effect.

The importance of being able to keep the fountain and its surroundings thoroughly clean is also too obvious to call for special comment, and of course the design of the fountain as regards strength and appearance is a matter largely of its location, except that no matter how it is placed the appearance of cleanliness is vital.

CONSIDERATIONS OF COST AND OF VALUE

Cost of mechanical cooling versus ice

In the narrowest sense, the economy of a mechanically cooled drinking water system compared to the same system ice cooled, will also invariably work out in favor of the mechanical method, assuming that the equipment is at all suited to this method. But such a comparison is of little value, since the system of distributing the water is almost invariably changed at the same time that the method of cooling is altered, and there are too many factors to permit any one answer to cover all cases. In the New York office of one large company, the cost for this service was cut, by installing a machine and a better system of distribution, to about 25 per cent of the former cost. At the same time, the service was very much more satisfactory to the office force.

It cannot be too strongly emphasized, however, that considering economy and cost of operation where it involves mechanical cooling, or cost of ice, is merely considering the one least important item in the account and one that may well be sacrificed to other more important considerations.

Influence of improved conditions on employees

In the case of industrial plants, one large element involved in arranging a good system of supply is the effect on the employees'

feelings. Consideration for the comfort and well-being of the employees has a direct effect on their attitude to the plant. While in general, the character of the labor force determines to a certain extent the conditions in the place of work, while stenographers, to take an example, will not put up with the same lavatory facilities as factory girls, it is equally true that the conditions in the factory have a controlling effect on the character of the help that will seek employment.

Influence of proper equipment on efficiency

It is not often possible to get an accurate estimate of the improved efficiency following the installation of proper drinking water equipment, since the organization of the work in many shops is too elastic to bring out clearly the full effect. That effect is present, however, no matter how completely it may be hidden. In a rolling mill, one roller working at less than full efficiency lowers the capacity of the entire mill. Tonnage once lost is lost permanently.

In fact, in any industry where the work is arranged in a sequence of operations the effect of any falling off in the efficiency of the individual shows itself immediately. This prompt discovery of inefficiency, indeed, is one of the advantages of such an arrangement.

This arrangement of the work in a close sequence requires the holding of extra men ready to throw in at points needing reinforcement. This need of reinforcement appears very quickly where the operations follow each other closely, as, for instance, when the work moves along on a conveyor. This condition may be observed in the large packing houses. It may also be observed on the assembling floor of one of the large automobile companies. And in such work as this, the amount of extra work required is dependent on the general physical condition of the men, and is a measure of their condition.

As stated above, the difference between factories in which the organization brings out these defects in efficiency and those in which it does not bring them out, lies simply in the fact that in one case the defects are seen and in the other case they exist unseen.

The labor element in cost of production

In American factories, the labor cost is the big item. When one analyzes the prestige of American machinery, it will be found

to be due to the designs, to the tools and methods—in other words, to American engineering and also the higher grade of labor which is attracted by the better pay.

Within the shop the greatest pains are taken with the equipment. Steam engineers are provided to take care of the steam power, a building and repair department is provided for the factory and its general equipment, and a mechanical engineer and electrical engineer supervise the machines, machine tools and the electrical equipment. The one item, however, which is most expensive of all receives too little attention. The human mechanism, which after all is the most complicated mechanism in the organization, the most sensitive and by far the most responsive to proper treatment and proper conditions, is allowed to work under conditions which are given only the most casual care.

In the case of one of the larger companies that have investigated this matter thoroughly, there has been found a marked decrease in the number of absences in the summer time due to cramps, summer complaint, etc., since a properly designed system was installed, and at the present time practically all the cases of absences from work during the summer originate in one small and isolated section of the factory which it was not practical to provide with properly cooled water and which is still served by means of ice.

In a large rolling mill in the Pittsburgh district, there were formerly from two to five men overcome on practically every hot summer day before a modern system of cooling the water supply was installed. Since that time, this number of cases of heat prostration will be the toll of an entire season, and in the case of one recent season, one day, July 5, accounted for every case that occurred that year.

CONSIDERATIONS GOVERNING THE LAYOUT OF A COOLING SYSTEM

Cleanliness

The importance of absolute cleanliness in drinking water systems cannot be too strongly or too frequently emphasized. All surfaces with which the water comes in contact should be smooth and accessible for keeping clean without any particular effort, because the help usually available for such service is not of a type that will give any great amount of conscience to the work. Obstructions such as

pipe coils and supports should be designed with this in view. Proper facilities for flushing the tank should be provided to further assist in keeping things clean.

In many designs of cooling system, it is impossible to prevent the formation of ice and the consequent deposit of salts that are present in all natural waters and that are frozen out of solution as the ice is formed. The accumulation of these deposits and of organic matter that generally is present and that is also frozen out of solution, makes proper flushing especially important. Although such matter as may be present is presumably harmless in normal quantities, it is possible that in some cases it may prove dangerous in the increased quantity which its segregation by freezing brings about. And even though this material may be harmless in a given case, its appearance does not tend toward making the water attractive. The greatest care should therefore be taken in designing a system to avoid the formation of ice, so far as it is possible to do so. This is a matter generally left, of necessity, to the refrigerating engineer.

There are a number of arrangements in common use for cooling the water. In one system, the water is distributed uniformly along the top of a bank of coils containing the refrigerating medium and is allowed to trickle down over these coils and to collect in a tank below from which it is pumped to the distributing system. This arrangement has the advantage of comparatively ready access for cleaning, without the waste of any great amount of refrigerated water. Another arrangement frequently used is the immersion of refrigerating coils in a tank of the water. This arrangement is less desirable than that above mentioned, because of the probability of ice forming on parts of the coils. The circulation of the water over the cooling surfaces is likely to be sluggish in spots, and in fact, is practically certain to be, so that the ice will almost invariably form to a greater or lesser extent.

A third system that is in more or less use, is the one in which a drum or series of disks containing the refrigerant is revolved in the water to be cooled.

In all of these systems, there is more or less danger of contamination of the water by impurities getting in through ill-fitting covers, unless this matter is given proper consideration.

Reducing heat losses

The limitation upon the area that may be served economically from a single refrigerating unit has not been generally recognized because of the relative newness of the subject. It has been found in general, however, that the length and diameter of water distributing mains insulated with the best pipe covering known, should not exceed about 2000 feet of 1½-inch pipe as a maximum, whether the main is arranged in a loop returning the water to the original point, to be re-cooled, or carries it to a second cooling station. This limitation is due to the heat losses into the pipe through the insulation, and power necessary to pump the water through the system fast enough to avoid too great a rise of temperature. Where longer mains are used, a result of failure to analyze the losses properly is that the temperature of the water will have to be too low to be used with safety at certain points, if its temperature is to continue low enough at the end of the loop to be palatable. The installation of such a system simply means that the expense of making it has been incurred and the real purpose of the work has been lost sight of.

In a recent installation in a large factory in central Ohio, the matter of length of mains was ignored, and the result was that the boiler and engine room force whose drinking fountains were supplied by water immediately after it had left the refrigerating machine, was compelled to drink water at so low a temperature—namely under 40°, that there was constant difficulty throughout the season from summer complaints of one kind and another.

It is, of course, impossible to draw the line between requirements calling for one and those calling for more than one machine without a study of local conditions, but, as the length of the circuit increases, the size of the mains to permit pumping the necessary quantity of water to avoid too great a range of temperature in the circuit increases rapidly, if the water is to be pumped without forcing the friction up above a proper limit, and with this increase the heat losses become excessive, while at the same time the cost of the installation is rapidly increased. In many cases the decreased cost of piping, due to the possibility of using smaller diameters of pipe and shorter circuits through which heat may enter the system, becomes a decisive factor in favor of installing more than one machine. Naturally, however, this matter is not of importance except in very large plants.

In laying out a drinking water system, there are obviously a number of factors which cannot be determined with any great degree of accuracy. It is important, therefore, that the capacity of the refrigerating unit shall be amply large to allow for the inevitable factor of ignorance in the laying out of the system and the further question as to whether it can be given skilled attention or not and whether this attention can be given frequently or only at considerable intervals, because in the latter case the capacity of the plant must necessarily be run at a lower point than where attention is more regular and more frequent.

A further matter calling for attention is that means must be provided to meet the requirements instantly when the period of heavy load comes on at the noon hour.

Further, the use of small units scattered at various points convenient to the more or less separated groups requiring fountains gives the system a flexibility as regards extensions that cannot be secured with the single central distributing plant. As additional buildings are constructed, the drinking water system corresponding may be added without interference with the existing system, whereas in a central system the mains are very likely to have been laid out of such size as not to permit their handling the large amount of water required without causing excessive friction.

Location of fountains

In laying out a system the approximate location of the fountains is, of course, determined by the requirements of the work. The number of fountains in a given location is determined by the number of people to be served. In general one fountain for every 100 persons to be served may be taken as a fair average, although the character of the work will affect this number, increasing or decreasing it as the case may be. In any case, the upper limit should be one fountain for every 200 persons.

If the fountains are placed too far apart, there is of course a loss of time going back and forth. No definite distance can be assigned. The distance must invariably depend upon local conditions.

One precaution is desirable in locating fountains; namely, to be sure that two fountains on different parts of the distributing system are not placed near together. Where there is even a very small

difference in the temperature of the water supplied, the people will always go to the cooler water even though the distance is considerably greater.

Insulation

The matter of proper insulation of drinking water piping is perhaps the most important item in arranging the piping system, except the design of the mains so that they may be short as possible.

Owing to the difficulty of placing the pipes in the ground in many cases and to the uncertainty regarding the dryness of the insulation where it is so placed, and therefore of its insulating value, the piping system is more often placed above the ground in passing from building to building. In any case, the heat losses through the insulation are generally the largest item to be taken care of by the refrigerating machine and too great emphasis, therefore, cannot be laid upon the importance of using the very best insulation possible.

There is a great mixture of motives that are effective at the present time in improving factory conditions. To the mind of one person, it is a matter of charity; to another, it is philanthropy and 5 per cent; to a third it is a question of what the law requires, and the law is requiring more and more all the time; to a fourth it is a realization that the prosperity and comfort of one man is bound up with the prosperity and comfort of every other—that we are dependent upon one another, and that, in a sense every man *is* his brother's keeper, even from the most selfish motive. However, whatever motive makes its appeal in any individual case, the fact remains that improved factory conditions are gradually coming more and more into consideration, and that conditions will continue to improve as a more intelligent understanding of their effect becomes general.

TREATMENT OF WATER FOR LOCOMOTIVE USE[1]

By W. A. Pownall[2]

Most of the railroads in the central part of this country use some kind of water treatment to reduce boiler troubles resulting from use of water more or less high in incrusting matter. Some roads are pretty well equipped with softeners, which by use of lime and soda ash remove practically all of the incrusting solids; some roads have these softeners for their worst waters only, some use proprietary anti-scaling compounds, and others use soda ash alone as a means of preventing scale formation in their boilers. It is the purpose of this paper to deal with the last-named and to outline the methods of applying the soda ash treatment, its advantages and disadvantages and the results obtainable.

Water as it is pumped contains two classes of mineral salts the amounts of which determine its fitness or unfitness for locomotive use, the incrusting salts and the alkali salts. The incrusting salts or "total hardness" may be divided into the carbonate hardness, mostly carbonates of lime and magnesia, and the "sulphate hardness" mostly sulphates of lime and magnesia. When water is boiled at atmospheric pressure or higher the carbonates precipitate, either as soft mud or a bulky scale on the heating surfaces. The sulphate hardness remains in solution up to 60 pounds pressure, but above that it crystallizes as a very hard porcelain-like scale on the heating surface. Metal surfaces thus insulated by this scale become much overheated, resulting in leaky flues, staybolts and shortened life of firebox sheets.

The alkali salts are usually the sulphate, carbonate and chloride of sodium. These remain in solution, increasing in amount as more water is boiled away, until such a concentration is reached that the water begins to "foam." Waters high in alkali salts are, on account of their tendency to cause foaming, undesirable for boiler use. It is usually possible in Illinois to find water low in alkali

[1] Read at meeting of Illinois Section, American Water Works Association, March 10, 1915.

[2] Water Engineer Wabash Railroad, Decatur, Illinois.

salts so the foaming trouble seldom bothers until the hard waters are made mildly alkali by treating them with soda ash. Farther west railroads often have to use waters high in alkali salts which cause acute foaming trouble, although this trouble is lessened by special treatment. In addition to these mineral salts surface waters at times carry considerable suspended matter, and decayed animal and vegetable matter, which aggravate the foaming tendency.

CAUSES OF BOILER TROUBLES

The primary cause of leaky flues, fireboxes and staybolts is unequal expansion and contraction brought about by overheating of the metal, due to it being insulated from the water by a layer of scale. These troubles will be accentuated by any sudden cooling of the metal such as might be caused by holes in the fire, working engine very hard and then suddenly shutting off steam and leaving shut off for some time, cold water from injector falling to bottom of boiler, and to washing boilers with cold water.

The average operating official does not concern himself with the condition of boilers as long as the engines are going over the road in good time without failing. The flues may have considerable scale on them and with careful boiler work get along in the summer without much leaking trouble, but cold weather soon starts an epidemic of engine failures on account of leaking boiler, and it is then that the need of water treatment makes itself felt. The chemist usually starts first after the district that is showing the most leaking failures, for a leaking failure means delay to traffic, and sending out another engine and crew to pull in the train and failed engine. This costs considerable money besides requiring additional engines where such failures are frequent.

TREATMENT

The prevention of scale formation may be accomplished by using water softeners which remove practically all of the hardness and suspended solids, or by treating each water with enough soda ash to neutralize the sulphate hardness, and provide a slight excess of soda ash, all of the scale forming solids being converted into a soft sludge which can be readily blown out through a properly located blow-off cock. Soda ash or sodium carbonate is found in some waters, and unless it is so high as to cause foaming trouble, waters of this type are desirable for boiler purposes in that they will not

form scale and require no treatment; but unfortunately most waters contain sulphate hardness and must be treated.

The soda ash is changed to sodium sulphate in the boiler, and locomotive boilers worked to full capacity and using surface waters will usually be in a foaming condition when this sodium sulphate and other sodium salts, in water from the boiler are over 2000 parts per million. Where only clear well waters are used this limit will be 2500 or even higher, and in stationary boilers, with their lower rate of evaporation and greater steam space, the foaming point may be 5000 to 6000 parts per million. The mud and carbonates precipitated in the boiler, if allowed to accumulate, may cause trouble in three ways:

1. The foaming tendency of the water in the boiler increases.
2. Heavier scale will form at times when treatment is light.
3. There is danger from mud-burning.

It is essential, therefore, that engines using soda ash treated water be equipped with suitable blow-off arrangement for removing the sludge from the boiler. Critical examinations of the deposits in boilers have shown that, where there is scale formation, the heavier pieces of scale drop out in the barrel and front of the side legs, while the lighter scales and mud are carried further back by the circulation of the water and deposited in the back of the side legs and in back water leg. With properly treated water there is no scale formation, and the sludge can best be removed by means of a perforated pipe extending across and lying on the back mud ring and connected to a blow-off cock located at back corner. The primary purpose of this blow-off cock is to keep the alkali salts in the boiler below the foaming point. Incidentally the sludge is removed, and where treatment is maintained full and continuous, engines can be run indefinitely without having to wash out boiler. The federal law requires boilers to be washed at least every 30 days, but where waters are high in incrusting matter a deficiency of treatment will result in rapid scale formation, and on such districts it is wise to wash boilers every two weeks rather than risk scale banks and burned sheets, if, by lack of supervision, neglect or other cause, treatment had become light. One passenger engine ran 10,000 miles without washout or change of water on an Illinois division using waters of average hardness of 280 parts per million and treated with one-half pound soda ash per 1000 gallons, yet at the end of the test the boiler showed no scale formation and only a small amount of soft sludge in side water legs.

AMOUNT OF BLOWING OUT NECESSARY

A pound of soda ash forms 1.34 pounds of sodium sulphate, and calculations show that when 12.42 pounds of soda ash have been used per 1000 gallons of water in the boiler, the sodium sulphate will amount to 2000 parts per million, and to prevent foaming water must be changed completely or enough blown out to keep concentration below 2000. A treatment of 1 pound soda ash per 1000 gallons necessitates blowing out $\frac{1}{12.42}$ or 8.05 per cent of the water used, $\frac{1}{2}$ pound per 1000 gallons, 4 per cent, etc. In stationary practice, where higher concentration can be carried, the amount of blowing off is much less.

This waste at the blow-off cock is the expensive item against water treatment. A pound of soda ash entails a waste of 80.5 gallons of water that has been heated to the temperature of boiler pressure steam, and a locomotive boiler carrying 200 pounds of steam will use 30.5 pounds of Illinois coal to heat this water. At $1.50 per ton this coal will cost 2.29 cents, the 80 gallons of water at 5 cents per 1000 gallons 0.4 cent, a total of 2.69 cents per pound of soda ash used. This will be less with lower steam pressures and where a higher concentration than 2000 can be carried, and there is of course no waste while bringing the water up to this foaming point.

Where treatment is heavy or waters contain considerable natural alkali, it becomes impractical to do the necessary blowing off, and it is cheaper and more satisfactory to change water in boiler frequently at terminals, or use some anti-foaming compound that allows a higher concentration of alkali salts before foaming occurs. Passenger engines should be washed out or have water changed often enough so that the terminal blowing off will keep the boiler from foaming without having to blow out en route.

The following procedure should be followed to overcome boiler troubles on any certain division.

First, get the best available water supply; second, provide suitable arrangements for blowing off engines and line up to have engines blown systematically at terminal and on road; third, treat all waters containing sulphate hardness with the necessary amount of soda ash, and fourth, provide sufficient chemical supervision, to maintain correct treatment at all times.

WATER SUPPLIES

Chemical analyses of the water in use for locomotives should be made, and where the sulphate hardness or the alkali salts are high, an effort should be made to locate a better supply that can be substituted at not prohibitive expense. In the past, railroads usually took the first water available, regardless of the quality, and there are many places where these old supplies, high in sulphate hardness, can easily be replaced by much softer water. The cost of treating the waters with the attendant cost of coal wasted as a result of this treatment should be considered in changing supplies, and it will usually be found that the better water will pay for itself in a short time.

BLOWING OFF BOILER

At roundhouses there should be a place for blowing off just before engine goes on to clinker pit, and hostlers should be instructed to blow out full glass of water from every incoming engine and should be held strictly to account for obeying these instructions. It is also a good plan to provide a similar arrangement on outgoing track to give enginemen opportunity to blow off before leaving. Enginemen are instructed through letters explaining the water treatment, blowing off, etc., and individually by their road foremen.

TREATMENT

Our methods of analysis may not appeal to the chemist, but we determine only the total dissolved solids, the total hardness by soap test, and the sulphate hardness by subtracting the alkalinity to methylorange from the total hardness. Every water containing sulphate hardness is treated with enough soda ash to neutralize this sulphate and provide excess, such that waters taken from boilers of engines using the treated water will show about 15 per cent of the total alkali salts as sodium carbonate. Probably only 5 per cent will keep the water in a non-incrusting condition unless the hardness is high, but the 15 per cent is carried as insurance against occasional neglect or deficiency of treatment at some stations.

The soda ash solution would best be used evenly according to the flow of water, and should go through a separate pipe line to the water tank so there will be a chance for chemical reaction before the

treated water passes into the pipe lines. The solution may be introduced by small steam pump, by plunger pump operated by main pump or water motor through which all the water passes; it may be forced continuously by air pressure, solution passing through a $\frac{3}{32}$-inch diameter hole; by a by-pass arrangement in which part of the water is by-passed from the main and displaces the solution in proportion to the water flowing; and when no other method is available it may be placed direct in engine tanks.

SUPERVISION OF TREATMENT

A very important feature of treating waters with soda ash alone is to provide enough chemical inspection and supervision to insure keeping all waters treated fully and with as little interruption as possible. If the treatment is light on account of neglect of pumpers or insufficient soda ash called for in directions so that the treated waters in general still show some sulphate hardness, then the only benefit is in the small decrease in hardness of the water, due to some precipitation of the carbonates in the supply tub. The foaming tendency of the water will have increased in proportion to the amount of soda ash used, and boiler must be blown off nearly as much as with full treatment; but the hard scale still forms on the flues and causes the leaking troubles that the soda ash is expected to cure. To keep treatment right a road water inspector should make frequent analyses of the raw and treated waters for sulphate hardness or sodium carbonate, and should also inspect apparatus for treatment. If this inspection shows treatment wrong he should do what he can on the ground toward adjusting matters, and report to division officials when other steps are necessary to correct pumper or repair apparatus. On some divisions where the raw waters do not vary much in quality at different times of the year and where there is a dependable class of men handling the soda ash, it will not be necessary to provide so much chemical supervision after treatment has been started and is going satisfactorily, and one water inspector may be able to handle two or three such divisions. On other divisions where the waters vary considerably in quality, where the pumpers are changing frequently or where slight falling off in treatment is followed quickly by boilers leaking, it pays to keep a water inspector on the division all the time.

RESULTS OF TREATMENT

The advantages gained by full and systematic treatment of water are as follows:

1. Engine failures due to leaky boilers are reduced to a minimum. On divisions where soda ash treatment has been in use for several years the records show an average mileage per engine failure due to leaky flues of 513,000 miles. The total yearly mileage on these divisions is about 10,000,000, all waters are treated and most of the engines are heavy power with flues 19 and 21 feet long.

2. Much less boiler work is needed, mileage of flues between shopping is materially increased and the cost of boiler repairs is correspondingly decreased. It is not necessary to shop an engine for flues before the machinery needs it.

3. Mileage between washings of boiler is increased.

4. There is a saving of fuel due to having boiler free from scale. Also a saving of the fuel that heats the water lost from leaking boilers.

5. Engine is not held out of service so much for washing and working on boiler.

The disadvantages are the increased foaming tendency of the treated water and the waste of coal and water in blowing off to overcome this foaming tendency.

The cost of water treatment can be given fairly closely, but it is rather difficult to give in dollars and cents the various savings due to treatment. Some estimates of these costs and savings are given here as so much per engine per year based on a freight engine of about 50,000 pounds tractive force using waters treated with an average of one-half pound soda ash per 1000 gallons.

Saving per engine per year

Boiler repairs	$250.00
Fuel 5 per cent of $7200	360.00
Washing boiler	40.00
Ten days extra service at $15 per day	150.00
	$800.00

Cost per engine per year

Soda ash 3000 lbs. at 0.85 ct. per lb	$25.50
Coal wasted 45.8 tons at $1.50	68.70
Water wasted 240,000 gals. at $.05 per 1000 gals	12.00
Supervision of treatment at 0.2 ct. per 1000 gals	12.00
	$118.20
Net saving per engine per year	$681.80

These figures are for a large engine under average water conditions. Where the waters are hard the saving in boiler repairs and fuel wasted on account of scaled boiler would be considerably higher. A number of years ago Professor Schmidt of the University of Illinois in tests on an Illinois Central engine reported a saving of 10 per cent in a clean boiler over the boiler with scale of average thickness $\frac{1}{16}$ inch. The percentage will run higher with heavier scale, and the assumption of a 5 per cent saving is conservative. The above net saving of $681.80 multiplied by a number of engines runs into a large amount of money, and shows the financial advantages of water treatment for a railroad.

Before closing the writer would like to say a word about treatment with barium salts. The great objection to the use of soda ash is the increased foaming tendency of the treated water, and this bad feature keeps many railroads and power plants from using soda ash. Barium hydrate precipitates the sulphate hardness, an equal amount of carbonate hardness and does not increase the soluble salts or foaming tendency of the water. It is therefore rather ideal for water treatment, but thus far has not come into general use on account of its high price. Barium carbonate is being used in Germany for water softening, it is just as cheap as soda ash, and has not the foaming objection. Settling tanks are necessary with the barium treatment, involving a larger initial outlay than with soda ash. Development of processes for using barium carbonate or decreasing the cost of making barium hydrate would increase very much the amount of water softened for boiler purposes.

KINKS IN THE CONTROL OF HYPOCHLORITE AT DENVER[1]

By W. W. De Berard

Hydraulic mixers of the type used in cyanide plants are employed to dissolve and mix bleach in the four installations which sterilize the water supplied by the Denver Union Water Company. Other novel details of these plants include the graduation of the scales on the solution tanks in pounds of solution and the control of the flow from the constant head box by special long-lever controlled plug cocks.

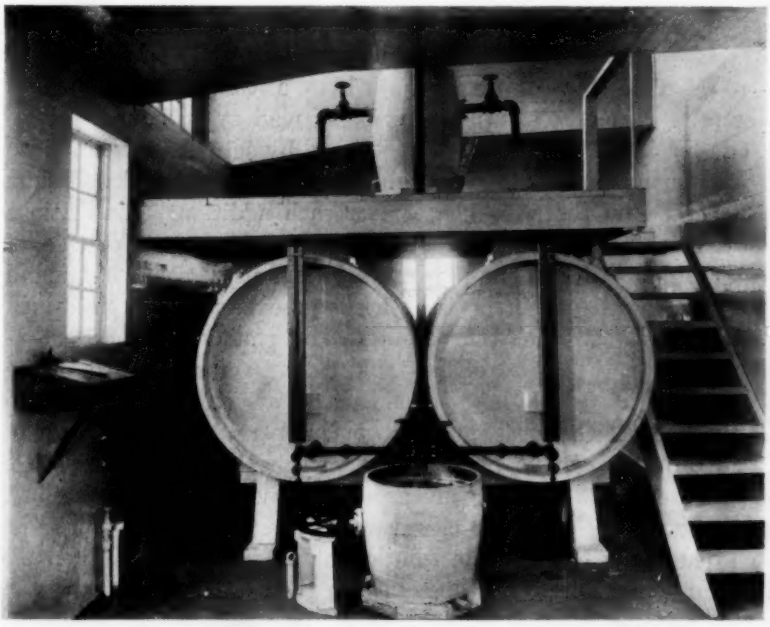
In the arrangement at Willard where there is a 10,000,000 gallon rapid filter plant, two horizontal solution tanks 12 feet long set 5-foot centers are made out of 48-inch woodstave pipe. Above one end of these tanks is a mixing tank consisting of a 50-gallon barrel with the necessary inlets, outlet pipes connecting the mixing barrel with the solution tanks, water supply and the drain. To agitate the chemical with the water in the mixer barrel, a 1-inch pipe entering at the bottom is reduced to a ½-inch nozzle which extends up into a 2-inch four-way cross. The side outlets of the cross are open. From the top outlet a 2-inch pipe extends above the top of the barrel and terminates in a tee into which are screwed nipples and turned down elbows. The discharge is thus given a downward motion. A branch carries part of the supply through the side of the barrel about 2 inches above the bottom. A 45-degree elbow with a ¼-inch nozzle on the inner end of this pipe gives the solution a whirling motion which throws all of the sediment to the center.

In operation enough of the dry chemical is weighed out, to make up a one per cent solution, and dumped into the barrel, which is full of clear water. Filtered water under 75-pound head is then turned on. The jet action of the water entering the tee at the bottom of the barrel pulls water and undissolved chemical into the central pipe, or hydraulic elevator as it is called, and discharges it at the top. The swirling motion of the water entering at the side of the barrel rolls the undissolved chemical constantly toward the center

[1] Read at meeting of Illinois Section, American Water Works Association, March 10, 1915.

where it is drawn into the elevator by the injector action of the water entering through the ½-inch nozzle pipe. Screens prevent lumps from passing to the storage tanks through the 2-inch overflows.

In half an hour practically all of the hypochlorite is discharged from the hydraulic mixer, and the storage tank will be one-half or two-thirds full. The remainder of the clear water to make up the solution to proper strength is brought into the bottom of the



SOLUTION TANKS

tanks midway between the bulkhead ends. Two-foot lengths of pipe terminating in ½-inch nozzles are screwed into a tee on the inlet pipe to give an additional mixing by the swirling motion produced. Numerous tests at the surface, center and bottom of the storage tank after standing 8 hours indicate a variation of less than 0.43 per cent.

SCALES READ IN POUNDS

Solutions of one per cent strength are invariably used. A glass gauge on the end of the tank is graduated to read directly in pounds

of chemical. Readings of the gauge are taken at one-hour intervals, and adjustment made if the necessary quantity is not feeding. By having the scale read in pounds a very simple calculation, as outlined in the *Engineering Record* of July 25, 1908, gives results in grains per gallon, sufficiently accurate for all practical purposes. Pounds used between readings divided by the product of the minutes between readings by the rate of flow of the treated water expressed in million gallons per day gives the grains per gallon applied within one per cent of the correct figure. Following the recent practice of expressing results in pounds per million gallons, the weir scales have been calculated to read in gallons per hour, so that one division gives results at once, the solution tank being read every hour.

Graduation of the scale is accomplished by actually weighing into it 200 pounds of water from a small barrel resting on a scale. Points are marked on the scale board after each addition. Graduations between these intervals are interpolated down to 10 pounds of water which with the one per cent solutions used means 0.1 pound of chemical. A 4 x 4-inch pine stick is grooved to admit the $\frac{1}{2}$-inch glass gauge flush with the outside. The pound marks, about $\frac{1}{2}$-inch apart in the center of the tank, extend across the face of the 4 x 4-inch stick, while the $\frac{1}{10}$-pound marks are on a graduated strip at the back of the glass, an arrangement permitting easy reading.

To obviate the etching of the glass tube by the hypochlorite, clear water is run into the tube as soon as the storage tank is filled, or the gauge cock may be closed during the filling operation so as to exclude the hypochlorite solution at all times. The difference in the reading due to the difference in the specific gravities of the water and the solution is too small to correct.

CONSTANT HEAD CONTROL

Instead of the usual orifice box a simple arrangement used by the company for some time in the feeding of coagulant solution at the Willard plant has been used with slight modifications for the hypochlorite of lime feed. The former coagulant rig consists of a 30-inch vitrified sewer pipe set bell end down and filled in with about 10 inches of concrete to make a bottom. Reliance was placed on the coagulant to insure tightness, but the pipe never leaked. A hole was drilled through the pipe just above the bell for the entrance of a $\frac{3}{4}$-inch brass pipe, which extended horizontally to an upturned ell

in the center of the vitrified pipe. A short piece of pipe was screwed into the ell long enough to rise a few inches above the concrete surface so as not to take in sediment. A constant head supply to this tank was furnished through an ordinary brass hopper ball cock. The outlet was through a plug cock with a lever handle extended by a wire pointer over a graduated board. The graduations were arbitrary as the cock was eaten out in time and gave increased discharges for the same setting. This was of little consequence so long as the cock did not leak, for reliance was placed entirely on reading the gauge on the solution tank for applying the correct amount of coagulant.

In the hypochlorite of lime plants the vitrified pipe was replaced by whiskey barrels. Ordinary ball cocks coated with paraffine or blocks of wood dipped in asphalt are used to keep a constant head and $\frac{3}{4}$-inch steam cocks with extended lever handles control the discharge. A fine adjustment screw with the fulcrum and nut set in tapered holes in a fixed quadrant, and the lever respectively allow the operator to remove the screw, flush the valve and replace the lever at exactly the former position. The plug in the cock is filed away for $\frac{3}{8}$-inch with a $\frac{1}{4}$-inch rat tail file to give a fine stream.

Design and construction of these various devices were carried out under the direction of D. G. Thomas, chief engineer of the Denver Union Water Company.

THE NEW FILTRATION PLANT AT QUINCY, ILLINOIS[1]

By W. R. Gelston

On the first day of September, 1914, one of the oldest mechanical filter plants in the United States was abandoned and a complete modern purification system was placed in operation at Quincy, Illinois, to take its place.

The old plant was built about the year 1891 under the O. H. Jewell patents and consisted of a stone masonry sedimentation basin 70 feet by 70 feet in area and 9 feet deep and 14 wooden tank filters 12 feet in diameter. There was also a small clear well under the filter tanks. This plant provided a sedimentation period of about one hour and the capacity of the filters was about 4,000,000 gallons per day under the usual rating for mechanical filters.

The new plant is of reinforced concrete with brick superstructure, steel doors and windows and it is absolutely fireproof. Three thousand yards of solid rock were excavated to prepare the site for the foundation and the entire plant rests upon solid rock. The east wall is also backed up by a solid limestone ledge which rises from 12 to 15 feet above the basin floors.

The concrete structure is 172 feet by 89 feet and the highest concrete walls rise 25 feet above the footings. Of the total area, the six 1,000,000 gallon filter units, with the pipe gallery, cover 40 feet by 89 feet at the north end. Adjoining the filters on the south, a space 12 feet by 89 feet is used for the main entrance and stairways leading down to the pipe gallery and up to the operating floor, and for the steam heating plant and coal bin. Then a space 24 feet by 89 feet is occupied by the forebays and mixing chambers. The remaining area, 96 feet by 89 feet, is used for sedimentation purposes.

Two complete coagulating, mixing, and sedimentation units are provided and connected in such a manner that they can be operated in parallel, in series, or either unit may be operated alone. They are of unequal capacity. The No. 1 unit provides for two-thirds of the total capacity and the No. 2 unit one-third.

[1] Read at meeting of Illinois Section, American Water Works Association, March 10, 1915.

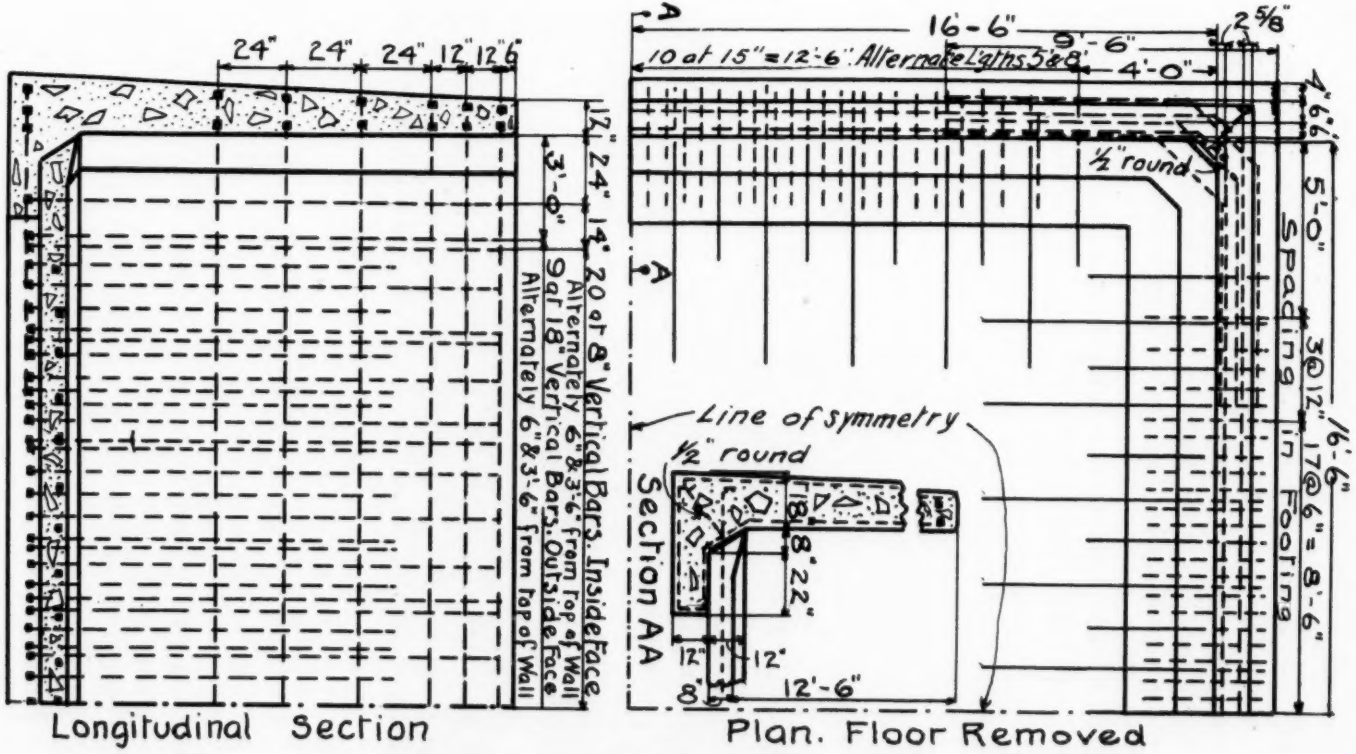
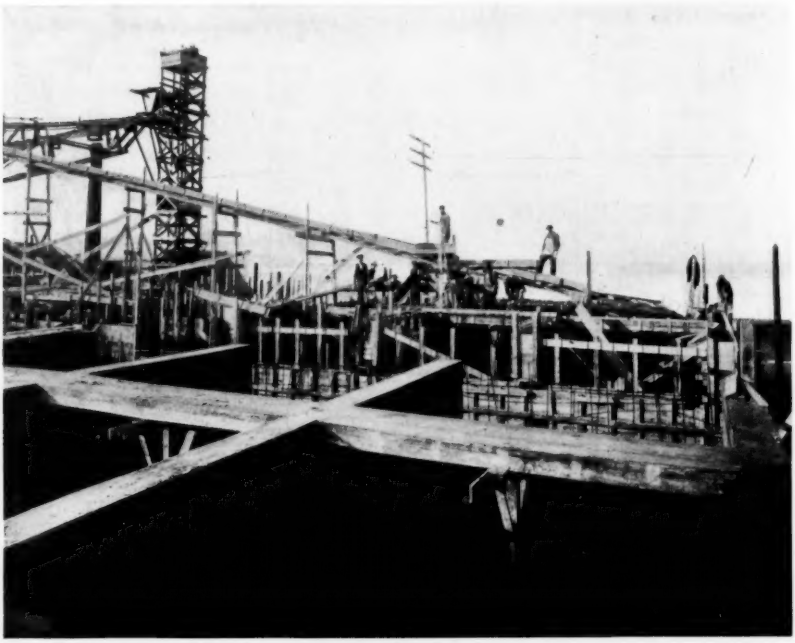


FIG. 1. DETAILS OF REINFORCEMENT OF WASH WATER RESERVOIR. ALL BARS ½ INCH SQUARE, TWISTED, OR EQUIVALENT, UNLESS NOTED

The short experience with this plant leads to the belief that the best results can be obtained by the series method of operating. The plant is therefore being operated as follows:

The low service pumps discharge into an open forebay where the water is treated with the first dose of sulphate of alumina. It then travels about 400 feet over and under the concrete baffles in the mixing chambers and finally passes through sluice gates into sedimentation basin No. 2. This basin is 27 feet by 94 feet by 20



FILTER PLANT DURING CONSTRUCTION

feet in depth and is provided with a vertical concrete baffle which extends nearly the entire length of the basin on the center line. When the plant is operating at a six million gallon rate this basin provides a travel of about 175 feet and a period of one and one-half hours for sedimentation. From the outlet side of this basin the water is drawn from the surface, over a weir, through a large sluice gate, and passes through a concrete flume to the second forebay where it receives its second dose of alum, as it begins its tortuous passage through the mixing chambers connected with Basin No. 1.

This basin is 55 feet by 94 feet by 20 feet deep with one vertical concrete baffle on the center line around which the water must pass. The sedimentation period in this basin is about three hours, making the total for both basins, four and one-half hours. The water passes from the outlet side of this basin to the filters.

Steel storage tanks, for coagulating solutions, are provided in duplicate for the alum and lime. A small electric motor is used to stir the solutions constantly to keep them of uniform strength.

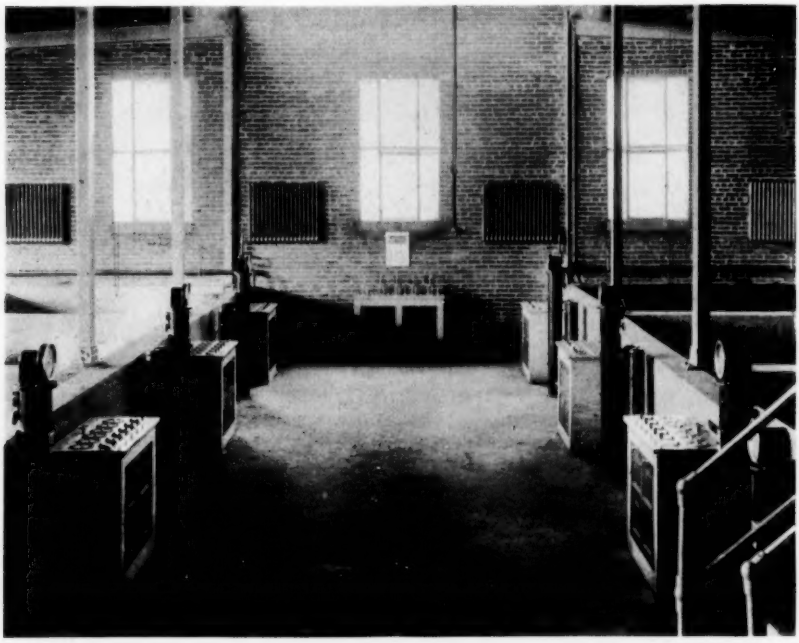
HEAD HOUSE

The coagulant feed is accomplished by means of constant head orifice boxes, the solution flowing by gravity from the orifice boxes to the forebays.

A complete hypochlorite sterilizing plant is also installed in duplicate. This solution flows by gravity and it is introduced into the filtered water as it passes through a 24-inch pipe line on its way to the high service pumps.

The six filters are grouped, three on each side of the pipe gallery.

They have a sand area 12 feet by 32 feet and they are 10 feet deep. The regulation strainer system, as designed for the combined air and water wash, is used. The strainers are covered to a depth of one foot with graded gravel and the sand has a depth of 30 inches. Ottawa sand of 0.38 of a millimeter effective size is used. Two steel wash water troughs run the entire length of the filters and provide a very uniform flow of water from the entire sand area during the washing process.



Operating Floor

The filters are equipped with loss of head gauges, hydraulic operated valves and the Venturi tube type of rate controllers. The space under the filter beds is used for storage of filtered water. The two basins 32 feet by 38 feet each in area and holding a depth of water of 9 feet provide storage capacity for 160,000 gallons. Since water for filter washing is taken from the clear wells the capacity is rather small and it would be entirely inadequate if direct pressure were maintained. Duplicate motor driven centrifugal pumps and

one motor driven blower comprise the necessary mechanical equipment for filter washing.

The brick superstructure is of handsome design. A buff colored St. Louis hydraulic pressed brick with a dark red brick for quoins and Bedford stone trim comprise an exterior of pleasing as well as substantial appearance.

The head house, which is 62 feet by 89 feet and two stories in height, is located over the forebays, mixing chambers and a part of

Mixing Chambers

the sedimentation basins. The second floor is of reinforced concrete supported by concrete columns and beams. This floor provides ample space for the storage and mixing of coagulants. The tops of the solution tanks extend 3 feet above the second floor and they rest upon concrete platforms which stand 5 feet above the lower floor. Numerous manhole frames and covers, set in the floor, provide access for cleaning and opportunity for study of the effect of the coagulants on the water as it passes through the mixing

chambers. Large rectangular openings, over the inlet and outlet of the sedimentation basins also provide convenient points for sampling and observation of the operating results.

A well-equipped water works laboratory is also located on this floor. It consists of four connecting rooms having a total floor area of 625 square feet, with well lighted work benches and sinks, and all of the apparatus and utensils necessary for the preparation of media and for the bacterial and microscopic examination of water.

The filters are covered by a one-story brick superstructure which rests upon the outside walls of the filters, leaving the entire area of the filter beds open for inspection. This room is well lighted by means of a monitor roof over the operating floor in addition to the windows in the side walls.

DISCUSSION

Mr. W. F. Langelier: The official test of the Quincy plant was completed March 1, but inasmuch as the report has not yet been submitted, the speaker wishes to withhold from discussion the results obtained, inasfar as the various guarantees are concerned. One or two unusual operating features, however, were observed and a discussion of them might be interesting to some of the members present.

It was noted that during December the filter runs, or intervals between filter washings, had become materially reduced, and for a few days averaged less than five hours. At this time the turbidity in the raw water was at a minimum and remained constant at 20 parts per million. The experience was similar to one noted during the test of the Evansville, Indiana, plant in 1912 at which time the trouble was ascribed to clogging of the sand by micro-organisms. At Quincy, however, microscopical examinations indicated only small numbers of organisms and moreover the settling basins were quite efficient in removing them. The number and size of the organisms passing to the filters daily was sufficiently small to make absurd the probability that they were directly clogging the filters.

Further investigation showed that the raw water was approximately 100 per cent supersaturated with dissolved oxygen and that the shorter runs were due to gas released in the gravel and underdrain system, probably as a result of the reduced or negative pressure caused by the sealed down draft. In this manner it is possible

to account theoretically for a very considerable volume of gas being released. The extent to which the length of runs may be affected, however, may depend on certain features of filter design by virtue of which the liberated gas is largely made to discharge with the effluent. The further disadvantages of air binding such as the possibility of gravel displacement are well known.

Excess oxygen in both rivers and lakes is a very common occurrence and in all probability much of the trouble being experienced in other filter plants by short runs and attributed to clogging by micro-organisms, is due to this same cause.

In addition to the fact that the raw water was only slightly turbid it was noted that it reacted pink to phenolphthalein indicating an absence of free carbon dioxide and suggesting photosynthesis as the cause of supersaturation. The trouble which lasted somewhat over a week disappeared as soon as the river became coated with ice and snow.

Another feature during the test, which was interesting to us, was the cause of an apparent reduction in the efficiency of the sedimentation basins. The average reduction of bacteria in the settling basins was equal to approximately 85 per cent. During the early part of February this efficiency began to decrease and for about a week a removal of 65 per cent was the best that could be accomplished. This reduced efficiency greatly increased the burden of the filters and it was evident that something had to be done if the guaranteed 97 per cent total removal was to be maintained. The basins had been cleaned only a short time previously and soundings showed that there was only an average depth of a few inches of sludge. There had been no change in the character of the raw water and there seemed to be no good reason for increasing the coagulant dose. It was finally decided to clean the sedimentation basin again, but before this was done several temperature readings were taken. Due to the season of the year it was found that the temperature variations were quite wide. The ice had just left the river a day or two before and much milder atmospheric temperatures were being recorded. The water admitted to the basins was in the neighborhood of 38° but after standing quiet in the basins over night the upper strata continued to rise in temperature. Thus, due to the increased density, a slight overturning, causing some disturbance of the sludge, occurred, and it was believed that this was responsible for the decreased bacterial efficiency. The basins were cleaned and, as

predicted, the average efficiency returned to the normal of 85 per cent.

MR. H. E. BABBITT: In answer to Mr. Langelier's discussion, the writer would like to ask whether there is any reason for suggesting the supersaturation of the water with oxygen. The most common reason advanced for supersaturation of water is the presence of some of the chlorophycae group, which organism possesses the property of giving off large quantities of oxygen, which is retained by the water. In examination of Des Plains River as much as 300 per cent saturation has been found, with visible indications of chlorophycae. In his description of his microscopic examination, Mr. Langelier did not mention the presence of an organism of this group. These organisms exist best in quiet water with relatively high temperatures. Violent agitation causes the precipitation of the oxygen. It is interesting to note that the mixing action in the reaction chamber was insufficient to cause the liberation of the oxygen, and that the reduced pressure in the negative head filter is sufficient to affect it. Practically all so-called "positive head" filters have some "negative head" at times, which might cause the troubles explained by Mr. Langelier.

FILTRATION PLANT, CITY OF DECATUR, ILLINOIS[1]

By Harry Ruthrauff

The main filter building covers the filters proper and housing all the piping and appurtenances necessary for the control and operation of the filters. The coagulant storage tanks and feeding devices contained within this building are at an elevation sufficient to permit the flow of the coagulant into the water as it enters the sedimentation basins.

Plans were prepared by William G. Clark, consulting engineer, which plans gave, in general, the necessary dimensions and the arrangement of the various basins and units of filtration, leaving to the bidders the detailing of the equipment for the filtration plant and chemical appliances, in accordance with plans to be prepared by them.

As is usual in these matters, the responsibility for the construction of the work rested on the bidders, and this was especially true as to the equipment; they furnishing their own plans and specifications.

The work was divided into several items upon which bidders could offer in part or as a whole. It was, however, provided that, "those bidding upon items 14, 15, 16, 17 and 18 must accompany their bid with as complete information as possible as to the size, character of raw water, results and cost of purification, etc., of the various plants which they constructed or equipped with appliances relative to water purification for domestic purposes."

As these items comprise the equipment of the plant, it is assumed that the successful bidder would be competent to carry out the various details because of previous experience in this very class of work.

A comparison of the various bids submitted with the items described in the specifications of W. G. Clark, C.E., develops the fact that of the bidders figuring on the construction work, only, items 1 to 13, H. C. Gass was the low bidder, and, of those bidding on the entire items, that is to say, the construction work plus the

[1] Read at meeting Illinois Section, American Water Works Association, March 10, 1915.

equipment, the New York Continental Jewell Filtration Company's bid was the lowest.

Certain changes were pointed out following the submission of bids whereby the low bidder on the entire contract, the New York Continental Jewell Filtration Company, offered to reduce their figures by the amount of $3000 on revised plans to be made by them, subject to the approval of the consulting engineer for the city, and this proposition was finally accepted under date of April 17, 1913.

Work was at once begun, and progressed as rapidly as was consistent with the development of the detail plans necessary to this character of construction.

This plant has now been in successful operation since September 23, 1914, the representatives of the company advised that the plant was completed and filtered water actually in the clear-water basin. The operator for the city was called in and his instructions started as per contract requirements.

Some difficulty was encountered subsequent to this owing to the fact that the city sewer was of insufficient capacity to carry off the wash water, and this was remedied.

As completed, the following detail of this plant may be of interest:

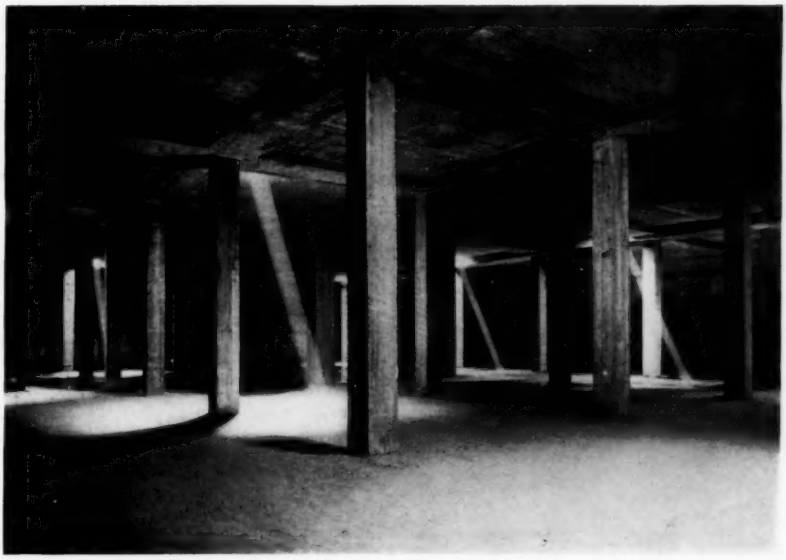
The excavation was in clay almost entirely, of such a character that the vertical walls cut clean, the deepest part of the excavation being that occupied by the sedimentation basins and the clear-water well, from elevation 990 approximately to elevation 1012.

The plant, outside of the sedimentation basins, occupied a rectangular space of approximately 138 feet by approximately 228 feet, and rested on a 6-inch concrete slab, reinforced with ½-inch steel bars, crossed both ways, so as to afford strength to carry the side walls and various columns.

The space within the rectangular above dimensioned was reduced by a quadrangle taken from the center of the rectangle, the space thereby eliminated being approximately 71 feet by 68 feet in dimension; and, through this quadrangle, is the entrance to the filter plant galleries and to the filters and to the head house and sedimentation basins.

The space occupied by the two sedimentation basins is approximately 105 feet by 121 feet; and, there being two basins within this space of unequal dimensions, one basin has an inside dimension of 49 feet 7 inches by 100 feet 6 inches, while the larger basin has a dimension of 66 feet 2 inches by 100 feet 6 inches.

These two basins are directly attached by a common wall to the



CLEAR WATER BASIN

GENERAL VIEW SHOWING PUMPING STATION, NEW FILTER PLANT, WITH THE OLD FILTER PLANT ON THE HILL

north side of the filtration plant contained within the rectangle above described; and, on the west side of the sedimentation basins and also attached directly to the north wall of the filtration plant proper, is the head house, which is superimposed above the smaller sedimentation tank in part, and also above a mixing chamber located beneath the head house and directly adjacent to the smaller sedimentation basin; the mixing chamber is 6 inches higher, in order to furnish sufficient head by means of which the treated water can pass from the mixing chamber to the sedimentation basins.

The outside walls of these sedimentation basins are 21 inches at the base of the wall, widening out into footings, the footings being 2 feet 10 inches by 14 inches. These walls taper from a 21 inch base to 15 inches at the top. The roof or deck over these basins is substantially 7 inches thick, resting on beams 8 inches in depth; the top of the slab being at elevation 1018; and the elevation of the floor of the sedimentation basins being at elevation 1000. Consequently there is a depth within the sedimentation basin of approximately 17 feet.

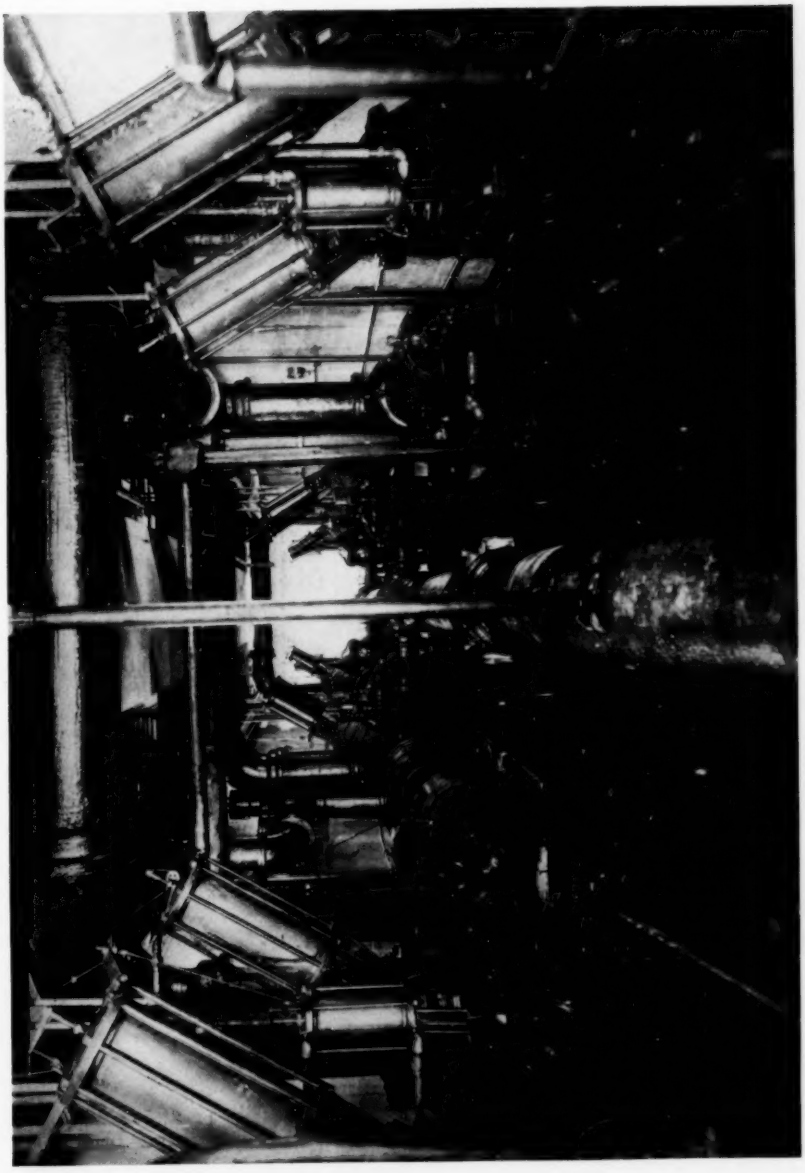
The walls of the sedimentation basins, the floor of same, as well as the beams and the roof, are heavily reinforced with steel bars, the amount of steel used in this portion of the construction being approximately 90 pounds per cubic yard. This is substantially the amount of steel also employed in the reinforcing of the clear-water well upon which the filters themselves are superimposed; the greatest percentage of steel being in the filter bottoms themselves, where approximately 95 pounds are used to the cubic yard.

The combined capacity of the sedimentation basins is approximately 1,500,000 gallons and the capacity of the clear-water well is approximately 3,000,000 gallons.

It will be seen, therefore, that there is in normal operation a period of approximately four hours sedimentation after the treated water leaves the mixing chamber and passes into the sedimentation tanks and, through them, on to the filters.

The actual area of the clear-water basin is approximately 25,000 square feet, and the depth is approximately 17 feet. The clear-water basin extends on either side beyond the filters themselves, and is decked over in much the same manner as described in the case of the sedimentation basins.

The clear-water basin is on both sides of the filters, and also connects through the space below the filters, so that the filter tanks are superimposed above the central part of the clear-water basin.



PIPE GALLERIES SHOWING HYDRAULIC VALVES, PUMP AND BLOWER

The filters are superimposed above a relatively small part of the area occupied by this very large clear-water basin, and are supported on concrete beams.

The filter units, six in number, are the air-washing type and are each 25 feet 6 inches by 21 feet 3 inches inside dimension—this being the space actually occupied by the sand bed contained within the filter tank.

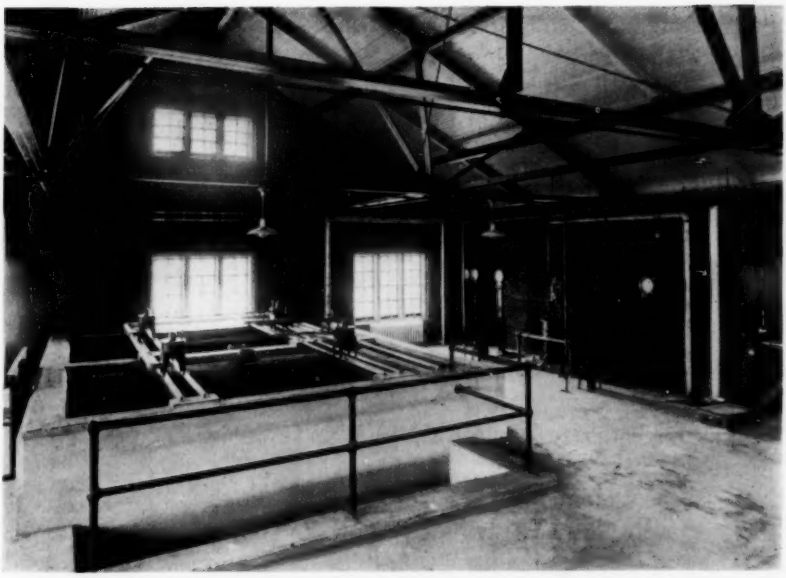
The filter tanks are 8 feet 6 inches deep from the top of the filter floor at elevation 1008 to the top of the division wall between the filters, which is at elevation 1016.45.

The walls of the filter building, which enclose the filters in part and house in the operating floor and the pipe gallery underneath, are pierced so as to permit a view from the operating floor to the extreme end of the filter unit, some 25 feet 6 inches, so that the entire filter is exposed to view from the operating platform. During operation the water from the mixing chamber passes through a flume to the sedimentation basins, entering on either side of the solid wall dividing these basins in two, and is controlled by 24-inch sluice gates at each point of entrance. Each of the basins is arranged with baffles, so that the water is forced to take a tortuous course from the point of entrance through each basin to the outlet, where the water, freed in large part of its suspended matter, is collected through another concrete flume located at a higher elevation than the inflowing flume first described. The baffles within the sedimentation basin are wooden construction, 1tted in concrete grooves.

In the construction of the baffles within the mixing chamber provision is made so that the water entering there, after receiving its dose of sulphate of alumina, is forced downward and upward to insure as perfect a mixing as possible before entering the sedimentation basins where a horizontal flow is permitted from the influent to effluent flume.

From the sedimentation basins, through the filter influent flume, the water passes by gravity on to cast iron gutters arranged above the sand bed of each filter unit and within the filter area. These gutters are located so as to act like weirs in this connection, spilling the water gently on either side of the gutter with the least possible disturbance of the sand bed beneath. A constant head of water is maintained over the gutters and sand bed beneath during the filtering process.

The water then filters at the approximate rate of two gallons per square foot per minute through the sand bed and gravel under-



Mixing Room Showing Motors

Operating Room Showing Three Filters on Each Side
One and one-half Million Gallon Capacity Each

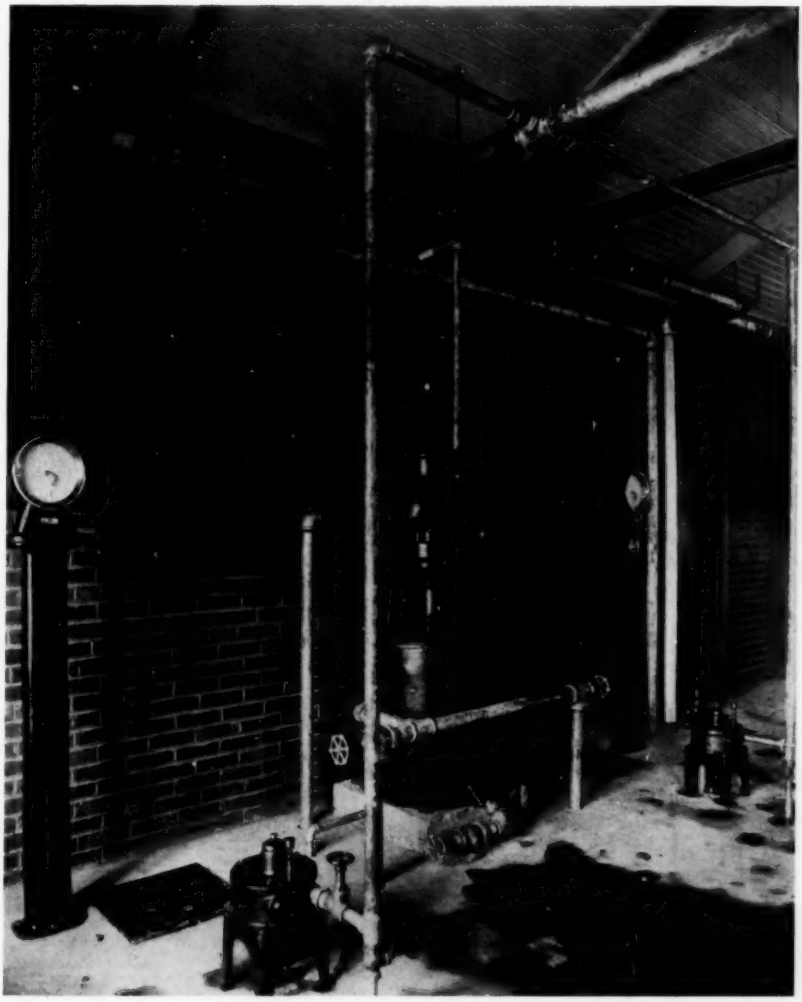
lying same and is collected through the strainer system and carried through the header piping to the controllers and thence into the clear-water well, whence it passes by gravity to a sump or suction well located just outside of the pumping house, a distance of some 300 feet from the filter building, and the large pumps supplying the city take their suction from this suction well, and force the filtered water to the city.

In washing the filters, one unit is thrown out of commission at a time, the influent valve being closed and the water within the filter tank permitted to filter down until it reaches a point about 4 inches below the top of the gutters above mentioned. These gutters during the washing period perform the function of carrying off the wash water to the sewer connection, the gutters being connected to a concrete flume so arranged as to collect the water evenly from the seven cast iron gutters located in each filter unit.

After the water is drawn below the gutters, the filtered water is forced upward by a centrifugal pump from the clear well through the header and manifold system and strainers underlying the sand and gravel bed at a rate of approximately $8\frac{1}{2}$ gallons per square foot per minute. Before the wash water is permitted to enter, however, a blower is started in operation, furnishing 3 cubic feet of free air per minute against a head of 4 pounds. The function of this freed air is to break up the bed and agitate same and assist the incoming wash water which follows to thoroughly cleanse the bed, passing off the impurities which have accumulated during the washing process into the gutters and thence to the flume connecting with the sewer, and through the sewer to the Sangamon River at a point below the intake.

As this new plant took the place of wooden filters installed many years ago, there was already installed and located within the pumping station, centrifugal pumps turbine driven, and these pumps now lift the water from the Sangamon River to the mixing chamber, thence through the sedimentation basin and filters to the clear-water well, where it finally reaches the high service pumps.

The coagulant devices are located on the second floor of the head house at an elevation of 1031, in general accordance with the engineer's printed specifications, and consist of two concrete tanks of the approximate dimensions of 14 feet by 7 feet 9 inches by 8 feet. These are the tanks for the storage of the sulphate of alumina and they are equipped with dissolving racks and provided with spray pipes and floats and apparatus for the automatic shutting



MIXING ROOM SHOWING MOTORS, GAUGES AND ALUM TANKS

off of the water when the solution reaches a determined height in the tank. This is in order to maintain a constant percentage solution when a given amount of sulphate of alumina is dissolved.

This plant is also equipped with hypochlorite of lime devices for the sterilizing of the water after filtration; and this apparatus consists essentially of two steel tanks mounted on steel supports at an elevation similar to that of the sulphate of alumina tanks above described.

The solution from both the sulphate of alumina and the hypo solution passes to duplicate orifice boxes equipped with apparatus for the accurate control of the solution which passes into the raw water at the entrance to the mixing chamber.

The hypochlorite apparatus is equipped also with a 24-inch diameter cast iron dissolving tank mounted over the hypo solution tanks and equipped with mixing agitators, belting, shafting, etc., and into this tank the hypochlorite of lime is placed and forced to become an emulsion before being passed into the steel tanks situated below, where it mixes with water and is stored in a percentage solution through automatic shut off apparatus.

While the sulphate of alumina solution passes to the mixing chamber, the hypochlorite of lime solution passes directly to the outlet of the clear-water basin so as to insure as intimate contact as possible with the clear filtered water as it leaves the filtration plant. The filtered water is thus sterilized as it passes to the suction well.

The building over the filtration plant is of ornate design, with slate roof, steel trussed; the brick used being a dark, hard-burned brick, and the inside of the building being faced with yellow hydraulic pressed brick.

On the operating floor within the building are arranged, at each unit of filtration, operating tables of Tennessee marble, oak panelled, and surmounted thereon, are nickel plated valves which control the operation of the filter, the plant being equipped with hydraulic valves for the purpose of operation; and loss of head gauges of the indicating type giving information as to rate of flow, time to wash the filter, etc.

On the top floor of the head house a large room is provided for storage of sulphate of alumina and hypochlorite of lime. Access is had to this floor by means of an elevator which communicates from the ground floor up to the storage and chemical mixing room, which are on the same floor.